Floods, flood management and climate change in the Netherlands

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Contents

Abstract

Climate change may well make very high river discharges more likely in the Netherlands. This follows from scenario calculations with models of climate and hydrology in the river basins of the rivers Rhine and Meuse.

Current policies and flood protection schemes may prove not to be adequate for dealing with increased flood risks. This study looks into the ability of Dutch institutions that relate to floods to adapt to climate change. An analysis of the contemporary history of flood risk policy making shows that institutions changed at the strategic level. The changes comply with the contextual, social trends of naturisation, integration, democratisation and internationalisation. Events, such as the 1953 flood catastrophe and the mid-nineties near-flood disasters, were the triggers to changes in flood management. Current flood risk strategies take account of a rise in the probability of hazardous river discharges, and take account of the inherently unpredictable nature of climate and river discharges.

Implementation of these new strategies, however, encounters many operational difficulties, since it has concrete impacts on many areas, particularly land use planning, hitherto largely separated from water management issues. An analysis of the advancements of the *Maaswerken* project - a series of works along the river Meuse that should simultaneously serve the interests of flood safety, navigability, gravel extraction and nature conservation shows that, when implemented, integrated planning is not able to take account of all intricacies, different interests and sensitivities of the many stakeholders. Spatial planning is an area most affected. Water management should become (again) a guiding principle in spatial planning.

Open planning - the substantial involvement of stakeholders in formulation of the problems and their solutions - could avoid impasses in decision making.

New flood risk strategies are based on extending floodplains and designating certain areas for retaining water. This is at the expense of the livelihood of local communities in those areas, but it does comply with strategies to (re)create natural areas in floodplains. The reactions of the residents of a village that would be mostly affected by one such scheme, show that, if communication is careful and two-way, they have some propensity to agree with the problem analysis, and may agree on relocation, if compensated.

In a rich, well-organised and technologically adept country like the Netherlands, adaptation to climate change may still be problematic, because project planning and implementation are very complex. This is acknowledged, and procedures are being streamlined, but progress is slow. Predictions are hard, as flood events will be important to the actual developments to come.

1. Introduction

Richard S.J. Tol[1], Nicolien M. van der Grijp[2], Alexander A. Olsthoorn[2] and Peter E. van der Werff[2]

1.1 River Flood Management and Climate Change

Climate change could well lead to increased risk of flooding of the Netherlands' major rivers, viz. the Rhine and the Meuse. There are polders along these rivers, which are densely populated and intensively used for agriculture, industry and transport. If the river dikes break or are overtopped, substantial damage would be done. In 1995, almost 2% of the Dutch population, still only a small fraction of the people living in the river flood plain, was evacuated because of flood warnings. Climate change thus poses a significant challenge for the water management community in the Netherlands. This report investigates whether Dutch policy making is up to this challenge.

Climate change continues to attract the attention of researchers of an increasingly diverse disciplinary background. Climate change impacts research is a growing part of climate research, and climate change impact research community gradually comes to the insight that impacts cannot be understood without understanding adaptation processes. Adaptation comprises the reactive and proactive attempts of individuals, companies and governments to reduce negative climate change impact and increase positive impacts.

In many cases, adaptation is more or less spontaneous. In other cases, where management is complex, information is scarce, resources are few, there is a multitude of stakeholders, or incentives are distorted, adaptation may be not at all easy. Water resources management in the Netherlands suffers from at least one of these conditions. Water management is extremely complex in a largely artificial, densely population, and democratic country like the Netherlands.

Among the many impacts that climate change would have, its effect on water resources is one of the most profound. This is because water is, on the one hand, essential and, on the other hand, scarce and badly managed. Downing *et al.* (1998) argue that, in Western Europe, water may be the only climate change impact sector that could cause substantial, negative effects on society. In the Netherlands, where water is relatively abundant and clean, the change in flood risk management has top priority in among all the policy issues related to water.

This raises questions such as: Do water managers realise that climate is changing? Do they recognise the implications for their tasks and objectives? If so, are they able to react timely and adequately? What constitute institutional barriers to implement certain proposed flood risk mitigation schemes? And what, given current societal trends, are the

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prospects for adapting institutions to find better and feasible responses to climate change? This report presents methodologies to address such questions and provides preliminary answers.

This report does not stand alone. It is part of the SIRCH project. SIRCH stands for Social and Institutional Responses to climate Change and climatic Hazards. This EU DG Research funded study was performed by seven organisations from three member States of the European Union -- Spain, United Kingdom and The Netherlands. The interdisciplinary team of social scientists, modellers, economists and hydrologists assessed adaptive responses to water resources risks related to climate change. The overall approach of this study was to perform three case studies, one in Spain concerning drought risk in the lower Guadalquivir basin in Andalucia, one in the Netherlands about flood risks in the lower Rhine-Meuse delta and one in England about droughts and flood risks in the Thames river basin. These studies, reported separately in reports like this one, provide a "real-world" focus for the conceptual and analytical developments, examining local adaptive responses and options for managing the transition to the changing climate and climatic risks of the future. A fourth volume will summarise the case studies and presents a series of overarching papers. See http://www.eci.ox.ac.uk/sirch/sirch.htm for more information.

1.2 Methodological Preambles

Most impact studies follow the same route, which is in fact the route recommended by the Intergovernmental Panel on Climate Change (Carter *et al.*, 1994, 1996; Parry and Carter, 1998). Essentially, an impact study starts with climate and other scenarios, then analyses impacts without adaptation, and finally investigates adaptation. Each step has its own cycle of screening, method selection, data gathering, calibration, analysis and validation.

Adaptation being the last stop on this route, it should not surprise the reader that adaptation receives the least attention in practice. Indeed, many a climate change impact study never got beyond the design of climate scenarios. This is unfortunate, because studies that completed the whole cycle typically conclude that adaptation explains substantially more of the variation in the final outcome than does climate (Cohen *et al.* 2000; Downing *et al.*, 1997; Mendelsohn *et al.*, 1994; Miller *et al.*, 1997; Tol and Langen, 2000; Yohe *et al.*, 1996).

Downing *et al.* (1996) therefore recommend that the IPCC method be turned on its head: start with adaptation and impacts, worry about scenarios later. This study follows that recommendation. We focused on analysing the ability of Dutch water management authorities to adapt to climate change. Throughout most of the study, we had only a vague idea about climate scenarios and impacts (cf. Chapter 7). These only became clearer towards the end of the study. The climate scenarios and impact estimates therefore serve as an illustration of what water management may need to adapt to. Our assessment of adaptation is not strongly conditional on the details of projected climate changes or impacts. Indeed, the reader may conclude with us that *adaptive capacity* is largely independent of climate and impacts.

The term adaptive capacity originates in the Third Assessment Report of the IPCC Working Group 2, Chapter 18. Adaptive capacity describes the ability of a society to successfully respond to changes in its environment, in this case, hydrological risks. Adaptive capacity depends on a whole range of factors, including technological ability, economic resources, distribution of resources, human capital, social capital, risk spreading, information management, and institutional capacity. We argue in Chapters 5 and 8 that the last, institutional capacity, is the main bottleneck for adaptation in Dutch water management.

If institutional capacity is the main problem, then the research should focus on the political and social aspects of adaptation. We try to do so. Besides economics, the social sciences have to date contributed little to climate change impact and adaptation research. We employ standards methods of anthropology, law and political science to our research questions, acknowledging that none of these three disciplines has a strong tradition in prediction. We also try to ground our analysis in observations. Many climate change impact and adaptation studies only look to the future, forgetting the lessons of the past. We first reviewed current and past water management practices in the Netherlands (Chapter 2). From that, we identified three crucial elements, viz. the definition of acceptable risk (Chapter 3), the public acceptability of water works (Chapter 6), and the administrative feasibility of water works (Chapter 5). These elements are studied more in-depth.

The methods used are a combination of literature review (water management is a major research subject in the Netherlands), analyses of legal documents, policy documents, professional magazines and media, interviews and brainstorming, also with people outside the research team.

In an earlier project, we also performed an historical analysis (Langen and Tol, 1998). We tried to build a quantitative model, but we did not get very far (Chapter 4). Although the model can describe some of its basic features, water management is too complex for formalised, mathematical analysis, that is, within our resource constraints.

1.3 The structure of this volume

This report contains nine chapters. Most chapters have been written as 'stand alone' papers. Chapters 2 through 4, review the past and current water management in the Netherlands. Chapter 2 sets the stage and describes the current institutional landscape and the major trends of the last 50 years. Chapter 3 focuses on the developments of the concept of risk and its position in flood risk management over the last fifty years. Chapter 4 goes further back. It looks, succinctly, at the last millennium, and tries to capture those developments in a game theoretic model.

The next two chapters go into the present and the near future. Chapter 5 reviews the administrative feasibility of flood management interventions, focusing on a case study of the Project Maaswerken in the South Limburg Meuse Valley. Chapter 6 present the results of a study of local stakeholders in the hamlet of Helhoek in response to ideas for flood risk mitigation schemes that would be at the expense of their community.

Then, we look at the future. Chapter 7 is on scenarios of climate, flood risk and society. Combining the scenarios with the lessons of preceding analyses results in an investigation of the options and abilities to adapt (Chapter 8).

Finally, Chapter 9 wraps up and draws conclusions for adaptation policy and research.

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2. Institutional framework for the management of the rivers Rhine and Meuse in the Netherlands – An overview

Nicolien M. van der Grijp[3] and Alexander A. Olsthoorn[3]

2.1 Introduction

This Chapter describes the present day physical and institutional features of water and water management inn the Netherlands. Section 2.2 summarises the physical geography of the Netherlands with special reference to the rivers. The geography is the context to be known for understanding the hydrological risks in the area and associated institutions. Water management policy in the Netherlands is viewed as an activity targeted at the various functionalities of water: water constitutes both resources and risks. Section 2.3 gives a concise over-view with some emphasis on the production of (drinking)water. This is of interest if comparisons are made between the different SIRCH cases. Section 2.4 deals with the institutional aspects of water management in general, including the legal framework, the formal and informal structure of water management (stakeholders), water policy planning, and international influences. Section 2.5 zooms in on flood risk management, as a specific policy field within water management. It deals with the development of flood risk management in the 20th century, including administrative structures, stakeholder involvement, flood control techniques, early warning systems and disaster management.

2.2 Physical geography of the Netherlands in brief

2.2.1 Introduction

To better understand the issues in water management in the Netherlands we shall - very briefly - describe some basic elements of the Netherlands geography.

2.2.2 The map

Two maps (a map of the Rhine/Meuse watersheds (Figure 2.1) and a map of the Netherlands (Figure 2.2) illustrate a number of distinct characteristics of the area of study:

- Most of the watersheds of the rivers Rhine and Meuse are beyond the borders of the Netherlands. The watershed of the river Rhine extends over Switzerland, Germany, France and the Netherlands. Thus, administrative borders do not map watershed borders;

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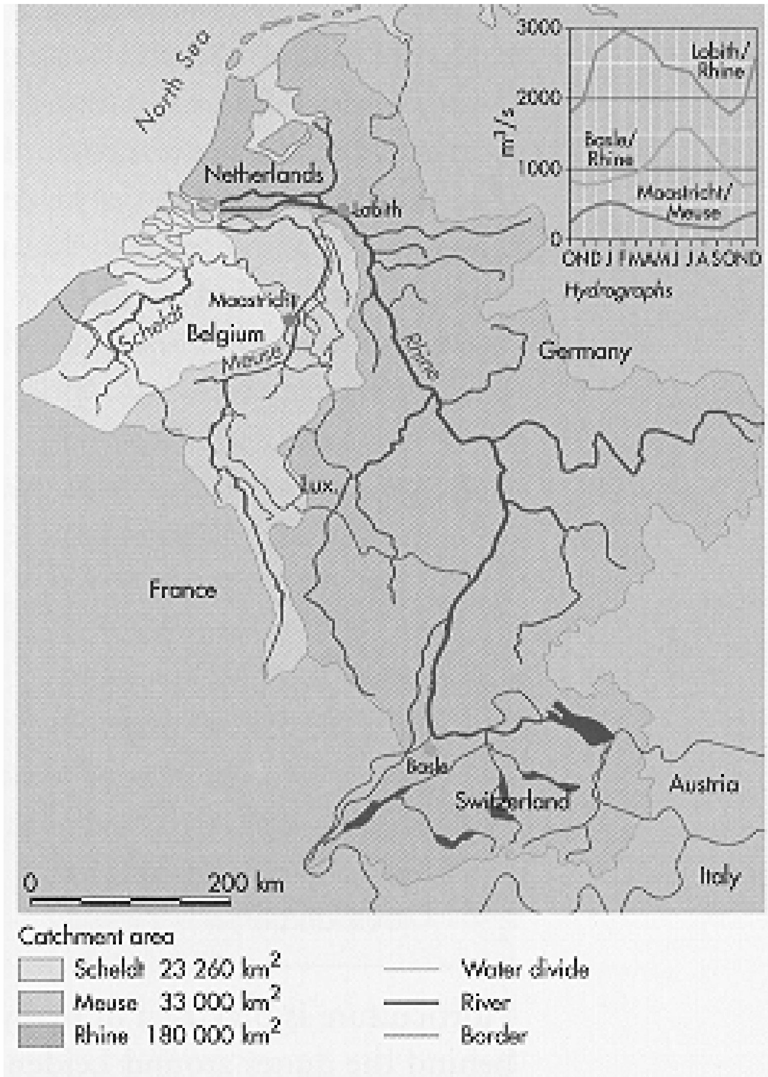

Figure 2.1 The catchment area of the rivers Rhine and Meuse. Source: Huisman et al., 1998.

- For the river Rhine, snowmelt is an important source of water, implying a rather constant discharge, on top of which rain-fed tributaries contribute to variability in discharge. The river Meuse is exclusively rain-fed, and has a more variable discharge;
- The river Rhine links the world's largest harbour (Rotterdam Seaport) with major centres of industry and population in North Western Europe. With the industrial revolution in the 19th century, the river Rhine has become a major artery of transport in this part of Europe, in particular for bulk commodities (*e.g.* coal, ores, petroleum products). This aspect makes for major differences with the other rivers that are studied under the SIRCH project;
- About half of the Netherlands' surface is either below sea level or below average river level. Over half of the population lives in these areas, where being at risk to

floods has always been a condition of life. Rooted in history, the main hydrological risk for the Dutch is the threat to personal safety.

2.2.3 Hydrological systems in the Netherlands

In a hydrologically complicated area such as the current Netherlands, the concept of a watershed is in its usual sense not quite appropriate for describing the hydrology in this country, since in most of the Netherlands surpluses of water have to be artificially removed. Figure 2.2 shows in what areas. The light areas given a number are all areas that run a risk of inundation by either sea or river. These areas are called dijkringen (dike ring areas). Each dijkring is a geographical unit bounded by its flood protection system (*i.e.* dikes). It is also a separate administrative unit under the Water Embankment Act (Wet op de waterkering). The shaded areas on the map are higher grounds that are not at risk to flooding, except for the river valley of the Meuse.

A recent analysis of the impacts of climate change, rising sea level and subsidence on Dutch geographical conditions (Raad voor het Landelijk Gebied, 1998) distinguishes five different hydrological areas in the Netherlands:

- The coastal and tidal systems (including the dunes along the coast and wetlands areas in the Northern part of the Netherlands and the in the Zeeland delta (dike rings 21-2);
- The rivers system (rivers Meuse and Rhine, its branches and the lower river delta);
- The Lake IJssel (IJsselmeer) system (the lake enclosed by the dike rings 7, 8, 9, 12 and 13);
- Regional systems: higher parts of the Netherlands;
- Regional systems: lower parts of the Netherlands (polders).

The latter four systems are hydraulically linked. The Lake IJssel (IJsselmeer) is mainly fed by the river IJssel (a branch of the river Rhine). Rhine water is pumped into many higher parts of the Netherlands in the event of a drought. Actually, in the same fashion, the dunes are linked to the river Rhine, since (pre-purified) Rhine water is used to recharge the fresh-water aquifers in the dune areas and used for production of water for suitable for drinking.

Some parts of the Netherlands run the risk of hydrological droughts. In the low-lying areas, droughts may result in of ground water becoming brackish.

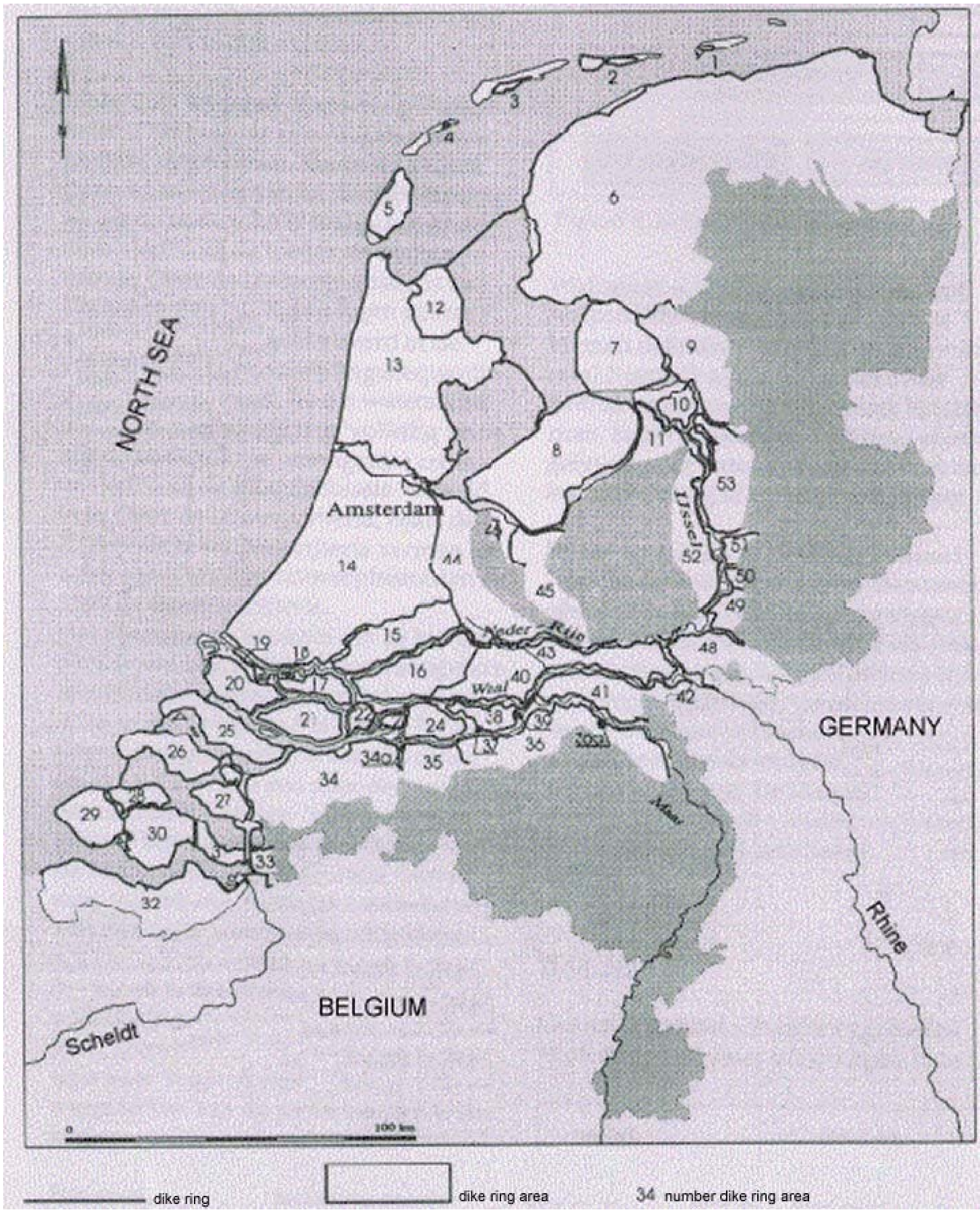

Figure 2.2 High and low grounds in the Netherlands. Dike ring areas (dijkringgebied).

A large part of the Netherlands is 'man made'. So, in a way, much of the geography of the Netherlands is a 'technological' artefact. Polders, dikes and systems for pumping water are most well known elements of the Dutch geography. In this respect we also mention river discharge management, which is to a large extent real-time controlled; by moveable dams in the rivers Lower Rhine (*Neder Rijn), Lek* and Meuse. In case of low discharges these dams are closed in order to maintain sufficient flow in the main river artery - the river *Waal* - to prevent silting by sea water from the mouth of this river and to control navigability for inland shipping. Other purposes of river discharge control are to have sufficient water (flow) in low-lying areas in order to prevent drought induced subsidence. This topic has top priority in water management. The semi-open dam that protects the *Oosterschelde* estuary to extreme high sea level (spring tide) is another example of control of extreme hydrological situations by man-made structures. Figure 2.3 gives an overview of the system.

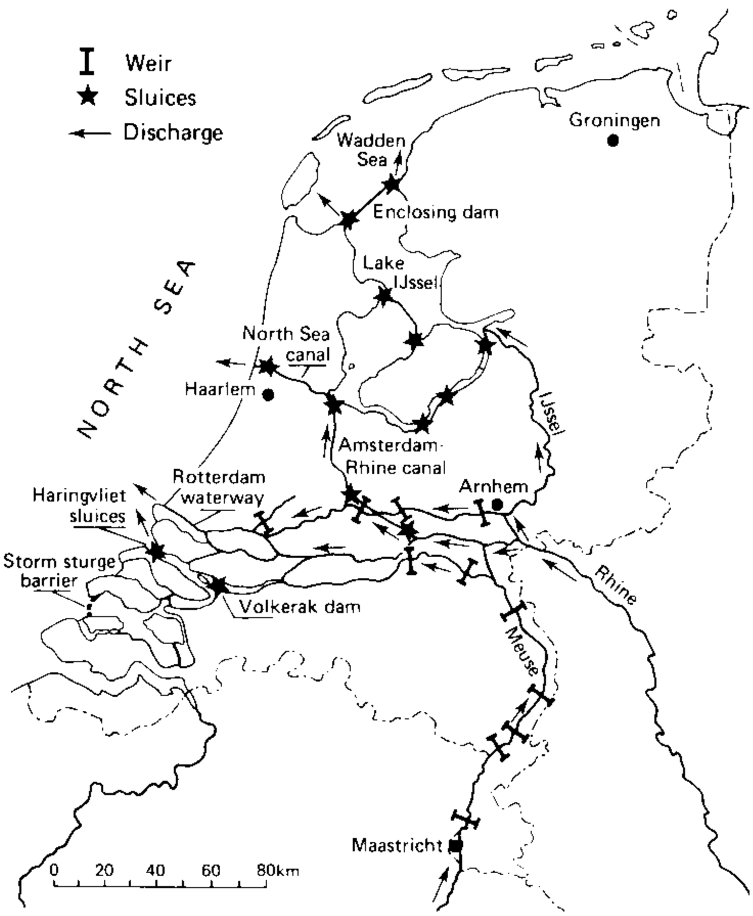

Figure 2.3 Control of Dutch hydrological system. Source: TNO, 1986.

About half of the Netherlands - the Western part - is below sea level, and millions live in these areas, protected by dikes. Also alongside the rivers Rhine and Meuse there are areas lower than average river levels. The roots of this situation are historical (see Langen and Tol (1998) for a concise description). Subsidence induced by agricultural practice is one of the processes that are part of this history.

The Netherlands is still vulnerable to subsidence. And human activities do still lead to subsidence: draining of clay and peat areas (for agricultural purposes of for building activities) leads to oxidation of soil material and subsidence; the use of groundwater in excess of groundwater supply has a similar result.

2.2.4 The water budget

The water budget for the Netherlands is shown in Table 2.1. This table highlights that the Netherlands is only a small part of a watershed; most of its input of water originates from beyond its border. This is one of the aspects that makes the Dutch case study distinctly different from the other SIRCH cases (rivers Thames and Quadalquivir). Table 2.1 shows that about 5 per cent (~ 5,000 million m³ per year) of all water that 'enters' the Dutch territory is somehow used. Most of the latter (about 80%) is used directly in agriculture and industries. About 1,250 million m³ is used by the water companies, for production of drinking quality water.

Table 2.1 Water budget of the Netherlands. Annual inputs and outputs.

Balance item	On average (million m³)	Dry year (1976) (million m³)
Precipitation	30,100	20,800
River Rhine	69,000	41,500
River Meuse	8,400	3,500
Other rivers	3,000	1,500
Total input	110,500	67,300
Evapotranspiration	19,500	20,500
Various uses	5,000	6,000
Discharge into the North Sea	86,000	40,800
Total output	110,500	67,300

Source: TNO 1986.

2.3 The water system: functions, resources and risks

2.3.1 Introduction

This section gives a brief overview of the functionalities of the rivers in the Netherlands. It reflects topics in water management as they are conceptualised and identified in a series of governmental white papers on water management. These white papers -the first of which dates back to the end of the seventies, the fourth of which was published in 1998 – define water management as the task to deal simultaneously with a number of topics of different nature, but all linked through "water". The topics are devised as a series of resources/services/hazards that are provided by the Dutch hydrological system (the *watersysteem*). Actually, since the 1985 white paper "*Omgaan met water*" (Dealing with water), these topics are called functions of the water system. The first column of Table 2.2 lists these functions, while the second column mirrors the risks associated with each function.

Table 2.2 Functions and hydrological risks as devised in the Netherlands water management. Source: White papers on water management.

Resources and services	Associated risk
Transport of water and ice from indigenous precipitation, but primarily from Germany, Belgium and beyond to the sea	Floods
Source of water for domestic purposes, agriculture, and industry	Drought
Source of minerals (clay for bricks, gravel, sand)	Depletion of mineral resources
Transport infrastructure (inland navigation)	Navigation interrupts
Resource for flushing stagnant water bodies	Silting, and other water pollution.
Resource for control of water levels in stagnant water bodies, and of groundwater levels	Subsidence (through oxidation of dry peat soil), depletion of ground water resources
Providing cooling water to power plants	Production interrupts, higher production costs
Fisheries	Depletion
Tourism and leisure activities	Shortage of leisure facilities
Biodiversity, nature, cultural heritage	Loss of biodiversity and nature

Table 2.2 lists functions and risks at random. However, decision-making requires the prioritising of policy measures that may be effective in relation to a specific policy issue. In other words: according to the political agenda, some functions may, at a certain moment, be considered to be more important than other functions. An historical analysis of the different policy documents with respect to prioritising reveals how the positions of the various items on the political agenda change over time. Flood safety has always been on top of the priority list. The present study also focuses on flood risk posed by the rivers. However, to provide for the context, we also describe other function/risk, though briefly. Only with respect to water as a resource for water companies, some more information is given, to provide for context that is of interest for the other SIRCH studies.

2.3.2 Flood risk

The river Rhine enters the Netherlands near the village of Lobith. The mean discharge is 2,200 m³/s. The highest discharge ever measured was 12,000 m³/s (in 1926, resulting in a dike failure near the city of Nijmegen). Lowest flow of the river Rhine ever measured: 623 m³/s in 1947 (in 1929 - with ice cover 575 m³/s). The mean discharge of the river Meuse near the village of *Borgharen*, where the river enters the Netherlands, is about 1500 m3/s. The extreme discharges of the Meuse river vary between 1300% and 0% of the average (230 m³/second), while the extreme discharges of the river Rhine range from 600% to 0.3% of the mean discharge. Thus the difference between mean level and high level is much higher in case of the river Meuse.

We shall distinguish two different areas at risk. For the upper part of the river Meuse, in the province of Limburg, the area at risk is the actual floodplain, of which some parts are protected by levees. In these areas the risk is a slow-onset type of hazard, the speed of an inundation equals the rate of increase of the river flow in case of high discharge. Downstream however, and along the river Rhine, the population in the areas adjacent to the rivers live in polders, which, in case of a dike failure (or overtopping) will be inundated suddenly by fast-flowing water.

The numbers for the damage done when under a high discharge dikes of these polders would fail, are in the order of a magnitude of tenths of billions Euro [4] (Walker, 1993). This number relates to only the expected economically measurable damage. Section 2.5 of this paper elaborates on flood risk policy and management in depth.

2.3.3 Water for drinking

Resources, demand and supply

The overall breakdown of fresh water resources that are used by water companies and the demand for water are in Table 2.3.

Table 2.3 Production and consumption of water suitable for drinking (situation around 1995).

Source	Production (million m^3)	Sector	Consumption (million m^3)
Surface water (rivers)	352	Industry	165
Groundwater	726	Domestic	660
Water from dune areas	22	Other	242
		Losses	33

Groundwater is the main source of potable water in the higher parts of the Netherlands (typical capacity of a groundwater resource is 5 million m^3 per year). There are 10 facilities for production of drinking water from surface water (directly or indirectly fed by the rivers Rhine and Meuse). These, together with the dune water resource, supply the large cities in the Western part of the Netherlands.

The system for producing drinking water from river water includes reservoirs that function as both a buffer and a first purification of river water. These systems were built in the 1960s and 1970s. One of the reasons for constructing these basins was to be less vulnerable to pollution in these rivers. So, when in 1986 warehouses of the Sandoz chemical industries in Basel were on fire, and large amounts of hazardous substances were flushed into the River Rhine, the Dutch drinking water companies had sufficient buffer capacity to wait until the wave of pollutants had passed. The reservoirs provide also some protection in drought periods when concentrations of pollutants (pesticides, nitrates) tend to

[4] This information is based on calculations for different scenarios with respect to discharges and dike failure risks.

rise.The main resources of fresh-water (drinkingwater[5]) for the Dutch water companies are the river Rhine, the river Meuse and ground water. Water of both rivers is directly purified (*e.g.* FeCl3 coagulation, filtering, oxidation (ozonisation), decalcification, sand bed filtration). Some water of the river Rhine is, after a pre-purification, also used for recharging ground water resources, in particular the resources in the dunes. The fresh water aquifers in the dune area along the shore of the Netherlands constitute historically the first modern resource of water. For the Western part of the Netherlands (including the cities of Amsterdam and The Hague) these aquifers are still an important resource.

Table 2.4 Breakdown of demand for water supplied by water companies in the Netherlands in 1995.

Sector	Million m^3	Per cent
Domestic sector (< 300 m3/y)	726	56.2
Institutional sector (300-10,000 m3/y)	260	20.2
Large consumers (> 10,000 m3/y)	186	14.4
Other water (not suitable for drinking)	62	4.3
Leaking	56	4.8
Total production	1290	99.9

Source: VEWIN, as cited by Twijnstra Gudde, 1997.

Table 2.5 shows the results of two consecutive inquiries among 2000 Dutch households to find a break down of water consumption in the domestic sector (Achttienribbe, 1996). The decrease in the consumption over the period 1992-1995 is significant. It is explained as the result of the policies of the drinking water companies to promote water conservation (a stated 11.1. litre/year) which has been off set by an ‘autonomous’ increase of 7.1 litre per year (Achttienribbe, 1996). The latter is the result of an increase in shower frequency and a 10% increase in the use of washing machines. Most of the water conservation is the result of shorter showers, the spread of the use of water conserving shower heads, and an increase in the use of water conserving type of toilet flushing systems.

Institutions providing drinking water

The origins of the current institutions for domestic water supply date back to the middle of the 19th century. In those days, the quality of surface water (canals, lakes) was deteriorating, particularly in conurbations. Under public health concern, primarily expressed by

[5] As opposed to water suitable for cleaning purposes only. Historically, in the 19th century new water supply companies (initially private companies that were given a concession by municipalities) evolved from concerns of public health. These companies produced water suitable – according to public health criteria - for human consumption. For some time these companies existed together with companies that supplied water for purposes such as cleaning. In recent years, there has been a tendency to again supply water for domestic use with different qualities (grey water). (Water companies did already supply ‘industrial-quality’ water to industries). Grey water can be produced from water resources at less cost, using less precious water resources. Especially in new town developments, the costs of the required double piping system may be compensated by the gains from water resource conservation.

NGOs[6], initiatives were taken to have available good quality water. The first[7] water supply firms were private firms that were given a concession by the local authorities. However, because of the costs of drinking water[8], not all population was reached, and the health concern remained. Public water supply was seen as the solution, and in the beginning of the 20th century water supply was taken over by firms that were owned by municipalities, groups of municipalities and provinces. In 1940, there were about 210 companies owned by public bodies. Nowadays, in the Netherlands, water is supplied by 37 firms.

Table 2.5 Per capita water consumption in the Netherlands.

Purpose of water consumption	1992 (litre per day)	1995 (litre per day)
Bath	8.6	9.0
Shower	42.5	38.3
Washing stand	3.7	4.2
Toilet flushing	42.3	39.0
Cleaning textile (by hand)	2.5	2.1
Cleaning textile (washing machine)	22.5	25.5
Dish washing (by hand)	4.9	4.9
Dish washing machine	0.9	0.9
Food preparing	2.0	2.0
Other	8.2	8.2
Total	138.1	134.1

Source: Achttienribbe, 1996.

According to the *Waterleidingwet*, the responsibility for security of water supply is in the hands of the Dutch National Government. The management of this responsibility is by law in the hands of the water supply companies[9] (*Waterleidingbedrijven)*. These companies are technically private companies, but they are owned by provinces and municipalities. Through these institutions – dating back to the beginning of the twentieth century - it was possible for municipalities (and provinces) to manage their responsibilities for public health.

In most parts of the Netherlands the consumption of drinking water is metered, and consumers pay according to their water consumption. In some parts (*e.g.* Amsterdam), consumers pay a lump sum. Recently, however, after a decision of the local council of Amsterdam, a programme to introduce metering was started. The water company expects a 12% reduction of water consumption as a result of metering and individual billing. Little

6 Part of the concern related to contiguous diseases that threatened also the bourgeoisie. In those days the NGOs were founded by the wealthy and educated people.

7 Actually these firms were not the first firms. There were already firms that supplied fresh water to high-sea ships and firms that supplied water during the winter, when canals and lakes were frozen. In the 19th century winters were more harsh than today.

8 In 1853, in Amsterdam fresh water was sold for 1 cent per bucket by the first drinking water company. This water was produced in the dune area and transported via a 25 km pipeline to Amsterdam.

9 These companies deal with production of water only. They are not involved in sewage (works).

protest was raised against this metering initiative. Unlike the English, - according to the case study in preparation about the Thames - , the Dutch do not seem to bother much about paying according to actual consumption.

The policy of making people pay for their water according to their actual consumption, fits into a trend for water conservation. The discussion on water conservation as an element of water strategies started in the end of the seventies. Tellegen *et al*. (1996) gave an overview. In particular, environmental voices spoke for conservation. Water companies initially opposed, they put forward the argument that restrictions on the use of water would threaten public health. Actually, this was the very first concern that prompted the initiation of public water supply in the middle of the 19th century. However, by the beginning of nineties, the voices for water conservation had become that strong that the Ministry of Housing, Spatial Planning and Environment (*VROM*) issued a white paper "*Actieplan Waterbesparing* (Action plan water conservation) in 1992. Table 2.5 shows that this plan was successful.

Currently (1999), the *Waterleidingwet*, is being evaluated. The start of this process has been a scenario investigation of the water industry, involving consultation of stakeholders in the industry (Twijnstra Gudde, 1997). The objective of this investigation was to examine different types of institutional structure for the water industry. The background of this project is the trend in public policy and administration to increase efficiencies by incorporating market incentives in the system. Other developments too (*e.g.* in technology of water production and distribution) warranted an evaluation of institutional structures around the production of water for drinking purposes. One of the issues being discussed is how, for the better, the supply of drinking water could be institutionally connected with the organisations that run sewage systems and sewage works. In contrast to other countries (*e.g.* the UK), in the Netherlands the organisation of the supply of drinking water is quite remote from the organisations that run the sewage works.

Privatisation as a means for enhancing efficiency of water supply is being discussed in the Netherlands, but there seems to be little support for comprehensive privatisation. Concern about water quality and the long-term nature of the industry are the main arguments for being reluctant (Tellegen *et al*., 1996). In June 1999, the National Government explicitly spoke against privatisation of the water industry[10], in reaction on initiatives by water companies and other utilities companies in the province of Zeeland to adopt privatisation.

Do policy makers take account of climate change as a development that might affect supply (and demand) of water? The Twijnstra Gudde report (1997) – which inventories the ideas on the organisation of the future production of drinking water among stakeholders - does not refer to climate change or a changing weather variability. Apparently, for the organisation of water production and water distribution, climate is not an issue in the context of how to organise supply of water. This conclusion does not hold for the strategies to manage water resources, since this area is the responsibility of the national government and beyond the scope of the water companies. We may observe that the water companies that rely on the river Meuse as resource, seem the most vulnerably, since

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10 Supply of water for domestic uses.

the discharge of this rain-fed river is more sensitive to periods of drought than the river Rhine[11] (van Deursen *et al.* 1998). With respect to demand there is no concern on the possibility of a changing pattern of domestic demand with conceivable climate change.

2.3.4 Inland shipping

The river Rhine is a major axis of transport of goods from Rotterdam harbour (and Amsterdam) to destinations in Germany and beyond. The expectations are that transport will increase (DGR, 1996).

Across countries, the importance of inland navigation differs greatly. Table 2.6 shows these differences from an economic perspective. In comparison with the UK, and, presumably, also Spain, in the Netherlands inland navigation is of great importance.

Table 2.6 The importance of inland navigation in different countries (1985).

	Performance (billion ton.km)	Performance (ton.km/million ECU GNP)
The Netherlands	33	200
Germany (FDR)	48	57
UK	2	4

Inland shipping is vulnerable to both high and low water. DGR (1996) gives figures for the costs to inland shipping, due to climate change induced low river discharges. These costs - resulting from draught restrictions that limit the cargo - range from € 75 million to € 0.75 billion annually, depending on the selected climate scenario and the reference scenario for the volume of transport (DGR, 1996 p. 132).

Since the river Rhine is a major transport route to Germany (and beyond), Germany has interests in the capacity of the river Rhine as a transport axis. In fact, German interests have been one of the incentives to the riverbed works in the end of the 19th century, that both improved the navigability and flood security of the river Rhine in the Netherlands. Nowadays, the German interest is expressed in an agreement on keeping the minimum deep and width of the stream at 2.8 meter and 170 meter respectively for 95% of the year[12]. This standard applies to the *Waal*, which is the Southern branch of the Rhine delta. The discharge of the *Waal* is controlled by moveable dams in the Northern branch (*Nederrijn* and *Lek*). Closing these dams results in higher discharge in the river *Waal,* improving navigability (see Figure 2.3).

In order to improve the navigability of the river for large pushing vessels (three barges), works are carried out to straighten a few tight curves in the *Waal.* The same holds true for the river Meuse, the navigability of which, through deepening and widening, is targeted to improve such that the river can take two-barge vessels. These works that increase the transport capacity are also in the interest of Germany.

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[11] The extreme discharges of the Meuse river (on the border of the Netherlands) vary between 1300% and 0% of the average (230 m³/second), while the extreme discharges of the river Rhine range from 600% to 0.3% of the mean discharge (2200 m³/second).

[12] Agreements on navigability are also made under the Commission of European Transport Ministers (CEMT), *e.g.* height of bridges over inland navigation ways.

In discussions on transport policies - road transport *versus* rail transport *versus* inland shipping - shipping is often considered as an environmentally more friendly mode of transport.

Institutions

The river Rhine is 'institutionalised' in different ways. The Rhine flowing through different countries has resulted in a number of international institutions. The one that is most important for the river Rhine (and its tributaries) as a means for transport, is the Act of Mannheim of 1868. This international agreement among the riparian states agreed on a free market for inland navigation on the river and it tributaries and associated canals (an institutional change of a toll good into a public good).

2.3.5 Flushing stagnant water bodies

Intrusion and seepage of silt water and discharge of pollutants (*e.g.* of fertiliser nitrates and phosphates) will progressively contaminate water bodies, if these are not flushed. In the Netherlands, water bodies in polders are at risk to this type of pollution, in particular during dry spells. In some areas, silting may also affect ground water and threaten the quality of agricultural soils. Flushing of these water bodies with fresh water of the rivers has been made possible by a series of (movable) dams in the branches of the river Meuse and river Rhine (see Figure 2.3). These were built in the late seventies and early eighties. The extremely dry summer of 1976, has been an event that spurred these constructions. Since the eighties, this risk is also reduced due to diminishing discharges of chloride from French potassium mines into the river Rhine.

It is of interest to note that in the policy analysis that underlie the *Deltawet*, that was passed after the great flood of 1953, the prevention of silting has been identified as a major side-advantage of the selected approach (closing estuaries) to ensure flood safety. In recent policy documents silting is not dealt with as an issue that constitutes a big problem. This conclusion is underpinned by cost-benefit analysis that has shown that national level measures to reduce the risk of silting by improvement of the availability of fresh (surface) water to agriculture are not desirable (GDR, 1996, p. 15). Also the rise of ecological values, as expressed in initiatives to preserve brackish tidal wetlands, may explain this change in policy evaluation.

2.3.6 Other functions of the rivers

Mining and quarrying

Traditionally, river beds have been sources for clay - used for brick manufacturing - , for sand - used as a building material (*e.g.* in concrete), and for gravel (also used in concrete). The mining results in the creation of lakes, many of which are used for recreation purposes. Chapter 5 comes back on the importance of gravel mining (river Meuse) and the links with flood safety and navigability.

Power production

In the Netherlands, three small water power facilities produce electricity. Total capacity is 35 MW, which is very small in relation to the total capacity of the Dutch power works.

Cooling water

A significant part of the Dutch power industry (Buggenum - Meuse, Nijmegen *Waal, IJssel centrale*) use river water for cooling purposes.

In the dry summer of 1994, lack of cooling water resulted in 30% shortage of power available for electricity production. The availability of river water for cooling purposes in the production of electricity is restricted by discharge permits. Water quality laws require that the water temperature may not exceed certain levels.

Current costs of these restrictions are about € 1 million per year (annual average). However, these costs refer to all power production in the Netherlands, including plants that use other sources of cooling water than the rivers Rhine and Meuse.

Tourism and recreation

Along the rivers, tourism developments have taken place, in particular yachting activities. In addition, works that will improve discharge capacity of the rivers (by excavating forelands) will result in nature conservation areas, expected to attract tourists as well.

Fisheries

Fishing is nowadays a minor activity economically. It should be noted that until the beginning of the 20th century fishing was important, salmon from the river Rhine was common foodstuff. Salmon (and other species) disappeared due to water pollution. Bringing the salmon back is one of the stated objectives of environmental policy with respect to the river.

2.4 Water management in the Netherlands

2.4.1 Introduction

This section outlines the institutional aspects of Dutch water management, including the policy fields of protection against flooding, quality and quantity management in relation to ground and surface water, and navigation[13]. Policy areas with a special relevance for water management are land-use planning, environmental management, nature protection, recreation, fisheries, and agriculture.

In the last 10 years, the emphasis in water management policy has increasingly shifted from a classical command-and-control, or top-down, approach, towards a more consen-

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[13] For an extensive description, we refer to the report “Institutional framework for water management in the Netherlands”, which was prepared in the framework of the Eurowater project (Perdok, 1996). Eurowater, funded by EU DGXII, provides a systemic comparative analysis of the institutional dimensions of water resources management in France, Germany, the UK, the Netherlands and Portugal.

sual, or interactive, approach. The same has happened in other policy fields, such as environment and nature protection. The consensual approach aims to strengthen the self-regulating capabilities of society, which should result in more effective and efficient policies and measures. An important feature of this approach includes stakeholder involvement in planning and decision making processes.

The outline of this section is as follows. The Sections 2.4.2 and 2.4.3 respectively give a general overview of the legal framework for water management, and a description of the formal and informal structure of water management. Section 2.4.4 deals with the instrument of water policy planning which performs a central role in Dutch water management. Section 2.4.5 describes the most important international influences. Finally, Section 2.4.6 deals with the trends in the institutional development of Dutch water management.

2.4.2 Legal framework for water management

In the twentieth century, water management policy and water management legislation have become increasingly interrelated (Van Hall, 1997a). The system of legal regulations concerning water management, or the law of water management, can be found in legislation at the central government level, and regulations at the regional and local level. The legislation at the central government level consists of:

- classic water management legislation;
- modern water management legislation;
- institutional legislation.

Classic water management legislation refers to acts that came into force around the turn of the century. The year 1970 marks the beginning of modern water management law as the Act on Pollution of Surface Waters (*Wet verontreiniging oppervlaktewateren*) entered into force. With this act, a period started of a more central role of the State in the assignment of tasks and competencies. In the period prior to 1970, the provinces had almost autonomous powers to assign tasks and competencies. Institutional legislation, finally, refers to rules elaborating the administrative structure of water management. Table 2.7 presents an overview of the prevailing Dutch water management legislation.

The formal water management legislation has generally the character of framework legislation which has to be elaborated by the executive authorities at the governmental, provincial, municipal and water board level. The Dutch law of water management, however, lacks a general umbrella act. In recent years, it was frequently discussed whether such an act would be necessary to achieve truly integrated water management. However, the government has been decided to refrain from legislative activities for the time being (Van Hall, 1997a). It is preferred to get first more practical experience with the concept of integrated water management.

Table 2.7 Overview of formal water management legislation in the Netherlands.

Laws with original titles in Dutch	Laws with titles in English translation
Classic water management legislation:	Classic water management legislation:
Waterstaatswet 1900 (Stb. 1900, 176)	Water Administration Act 1900
Rivierenwet van 1908 (Stb. 1908, 339)	Rivers Act of 1908
Deltawet (Stb. 1958, 2460)	Delta Act
Deltaschadewet (Stb. 1971, 86)	Delta Damage Compensation Act
Modern water management legislation:	Modern water management legislation:
Wet verontreiniging oppervlaktewateren (Stb. 1971, 444)	Act on Pollution of Surface Waters
Grondwaterwet (Stb. 1981, 392)	Groundwater Act
Wet op de waterhuishouding (Stb. 1989, 285)	Water Management Act
Deltawet grote rivieren (Stb. 1995, 210)	Delta Act Large Rivers
Wet op de waterkering (Stb. 1996, 8)	Water Embankment Act
Wet beheer rijkswaterstaatswerken (Stb. 1996, 654)	Act of State Water Authority Operations
Institutional legislation:	Institutional legislation:
Waterschapswet (Stb. 1991, 444)	Water Board Act

2.4.3 Structure of water management

Formal water management structure

The Netherlands is a constitutional monarchy with a parliamentary system. The central government consists of the King (Queen) and the ministers. However, since the King is inviolable, the ministers have full responsibility. Decentralisation is an important feature of the Dutch State organisation. The governmental hierarchy consists of the national, provincial and municipal level. For water management, functional government units exist at the regional and local level.

Public water management was first introduced in the Netherlands in the twelfth century (van den Berg and van Hall, 1997). It had traditionally a strongly decentralised character, resulting in a large regional variety of public bodies dealing with water issues. The basic principles, which still rule the current division of authority, were originally laid down in the Constitutions of 1814 and 1815. Since then, local and regional water management rests with the water boards, under the supervision of the provinces and the supreme supervision of the central government. With the Constitution of 1848, a strict separation of water management and other administrative concerns was carried through.

The revision of the Constitution in 1983 provides another important landmark in the historical development of water management, because the water boards got a constitutional position comparable to those of provinces and municipalities. The revision finally led to the coming into force of the Water Board Act (*Waterschapswet*) in 1992 which confirms the central position of the water boards in regional and local water management. Until then, there had been big differences in autonomy between the water boards mainly because of divergent provincial regulations and viewpoints.

The present administrative structure and division of responsibilities concerning Dutch water management is based on the Articles 21 and 133 of the Constitution, and the Articles 1 and 2 of the Water Board Act (*Waterschapswet*), focusing respectively on the central government, the provinces and the water boards. The constitutional regulations are further elaborated in the Water Administration Act 1900 (*Waterstaatswet 1900*) which contains provisions on the supervision of the provinces and the supreme supervision of the central government. Recent legislation, including the Water Board Act (*Waterschapswet*) and the Water Embankment Act (*Wet op de waterkering*), has largely replaced the Water Administration Act 1900 (*Waterstaatswet 1900*).

Due to the patchwork of legislation regulating different water management tasks, the administrative structure of water management in the Netherlands is rather complex. However, there has been some improvement since the entry into force of the Water Management Act (*Wet op de waterhuishouding*) in 1989 which provides the instruments to tune the policies of different water managing authorities. In addition, regional responsibilities are presently being rearranged aiming at a situation of ownership, management and maintenance by only one administrative unit, preferably an all-in water board. Table 2.8 summarises the main competencies in Dutch water management.

Table 2.8 Main competencies in Dutch water management.

Government levels	Competencies
Central Government	Strategic national water policy
	Water management legislation
	Management of national surface waters
	Supervision over provinces, water boards and municipalities
Provinces (12)	Strategic ground- and surface water policy
	Operational groundwater policy
	Supervision over water boards and municipalities
Water boards (65)	Operational surface water management
	Flood risk management
Municipalities (572)	Sewerage management

Based on Perdok (1996) and Mostert (1997).

At the government level, the ministry of Transport, Public Works and Water Management (*V&W*) is responsible for water management in general, including strategic water management policy and formal legislation. Its operational department is called the State Water Management Authority (*Rijkswaterstaat*). In addition, several other ministries have responsibilities concerning water management policy. The most important are the ministry of Spatial Planning, Housing and the Environment (*VROM*), and the ministry of Agriculture, Nature Protection and Fisheries (*LNV*).

The provincial governments (12 in total) formulate strategic and operational water management policy within the framework set by national policy. They are directly responsible for groundwater quality and quantity management. Further, the provinces have the authority to establish water boards, and to define their tasks and powers. The water management tasks of the municipalities are in general limited to the construction and maintenance of the sewerage system. Furthermore, they fulfil important tasks in local land-use planning and environmental policy.

The water boards, organised according to geographical and hydrological units, are responsible for regional and local water management. Their tasks may include quantitative and qualitative water management, and flood risk management. Fragmentation of authority has always been a characteristic of their administrative structure. Some water boards are only responsible for quantity management of surface water ("traditional" water boards), some for quality management of surface water (purification boards(*zuiveringschappen*)) and others for both quantity and quality management (‘all-in’ water boards).

The large tidal flooding of 1953 was the impetus to start a process of administrative concentration of the water boards, because it seemed necessary to strengthen their financial basis (van den Berg and van Hall, 1997). Between 1950 and now, the number of district water boards decreased from approximately 2750 to 65, and under influence of the Water Board Act (*Waterschapswet*) of 1992, water management tasks are increasingly put in the hands of all-in water boards.

In relation to the position and organisational structure of the water boards, the national government and the union of water boards (*Unie van Waterschappen*) commissioned several studies during the 1960s and 1970s (van den Berg and van Hall, 1997). A first commission advised on the rationale of water boards. It concluded that water boards are the most appropriate authorities to perform local and regional water management. Their organisational form based on functionality, and the linkage between interest, payment and participation in decision making were considered to be important strong points. Furthermore, the commission was of the opinion that water boards have to be financially independent of provinces and the national government.

A second commission studied the composition of the managing committees of water boards. To increase their democratic value, it was recommended that citizens should indirectly participate in the decision-making processes of water boards. A third commission advised on the financial structure of water boards. Finally, the proceedings of these three commissions formed the foundation for the Water Board Act (*Waterschapswet*) and Article 133 of the Constitution, legally establishing the responsibilities of the water boards.

Water boards have specific characteristics. One of these is the principle of ‘the unity of pay, say and interest’. This means that only those with an interest in local water management should pay for the activities of the water boards (through taxes and levies), and that they should be represented in the board. Initially, only landowners and other people with specific legal rights related to immovable property were considered to have a particular interest in water management. However, in the course of this century the circle of people with an interest was increasingly considered to include a wider variety of stakeholders.

Presently, five categories of persons are taken to have an interest in the functioning of water boards: the owners of unbuilt areas (primarily farmers), the renters of unbuilt areas (also primarily farmers), the owners of buildings, the users of buildings for commercial purposes (industry), and, since 1992, the inhabitants of the area (Mostert, 1997). According to Katsburg (1996), the owners of ‘unbuilt’ occupy 34% of the water board seats, the renters 1%, the owners of buildings 25%, the users of buildings for commercial purposes 7%, and the inhabitants 31%.

Elections take place by direct or indirect voting. Especially in the categories of owners of buildings and inhabitants, the turnout at direct elections is rather poor: usually not above 20% (Gilhuis and Menninga, 1996). Although farmers are still strongly presented in the water boards, the influence of “green” representatives has increased in recent years.

Water boards have to bear the costs of local and regional water management. An exception is made in case of management tasks that serve national interests. Practice shows that water boards differ in opinion about the definition of “national interests” (van den Berg and van Hall, 1997).

From a constitutional point of view, municipalities and water boards function at the same government level. The growing complexity of institutional arrangements in recent years has resulted in an increase of interactions between both authorities, especially in relation to land-use planning.

Informal water management structure

Water management is not only determined by its formal structure. It is even stated that in the Netherlands the informal structure is far more important than the formal structure (Mostert, 1997). This informal structure consists of all kinds of interactions between stakeholders that are not ruled by law. Among the stakeholders of water management are the general public, consumer organisations, environmental organisations, press, farmers, industry, drinking water suppliers, professionals (especially technicians), scientists, politicians, and public officials. These stakeholders may exert their influence individually, or in some kind of institutional arrangement. Public authorities, for example, meet each other in official associations at all state levels, including the Association of Provinces (*InterProvinciaal Overleg*, the Union of Water Boards (*Unie van Waterschappen),* and the Association of Dutch Municipalities (*Vereniging van Nederlandse Gemeenten*), and the Commission Integrated Water Management (*Commissie Integraal Waterbeheer)*. Private and business interests usually have their own organisational structures.

Because of the importance of the informal interactions, it has been concluded that water management policy in the Netherlands is not the result of an open debate in formal "arenas" such as parliament, but is formulated in an "iron ring" around the formal arenas, consisting of public officials and the different affected interests (Mostert, 1997). Formally, policy tasks and competencies are shared by numerous public authorities at the national, provincial, municipal and water board level. However, due to the rather low political profile of water management and the technical expertise required, most water management policy is in practice formulated by public officials in consultation with economic stakeholders and environmental NGOs (Mostert, 1997). Privately owned companies play no significant role.

Characterisation of the Dutch water management structure

The administrative structure of water management may differ between countries. Mostert (1998) distinguishes the hydrological, the administrative and the co-ordinated model. According to the hydrological model, the organisational structure for water management is based on hydrological boundaries and extensive river basin planning. In its most extreme form, all water management is in one hand: the ‘river basin authority’. The administrative model is in many respects the opposite of the hydrological one. According to this model, river basin management is part of environmental management, conducted by regional and local authorities, such as provinces and municipalities. The co-ordinated model falls somewhere between the hydrological and the administrative model. One of its main features is that, although water management is not performed by a ‘real’ river basin authority, co-ordination of relevant policies is otherwise guaranteed at the river basin level.

Mostert (1998) concludes that, although the organisational structure of the Dutch water management system is partly based on river basins (the water board districts), it is in the first place an example of the co-ordinated model, because co-ordination is provided in many planning procedures at different state levels.

2.4.4 Water policy planning

Water policy planning plays a central role at all government levels, and is perhaps the most prominent characteristic of Dutch water management policy and even of all Dutch government policy (Betlem, 1997). The State Water Management Authority (*Rijkswaterstaat*) co-ordinates the formulation of the strategic national water management plan and prepares the operational management plan for the waters managed by the State. The provinces make strategic water management plans for all waters within their area. The water boards that manage the regional surface waters make operational management plans for their area. In the Netherlands, planning is largely based on the consensus model. Central in planning are consultation between different government bodies and stakeholder involvement. It was in 1989 that the planning system for water management was legally embedded in the Water Management Act (*Wet op de waterhuishouding*).

The strategic water management plans at the national and the provincial level are co-ordinated with the strategic land-use plans and environmental management plans at these same levels. However, co-ordination may prove to be difficult as the legal status and the planning procedures differ, plans are adopted at different moments, and different government bodies have primary responsibility (Mostert, 1998).

The prevailing plan at government level, the 4th Strategic Water Policy Plan (NW4), was presented in December 1998. It is the product of close co-operation between the ministry of Transport, Public Works and Water Management (*V&W*), the ministry of Agriculture, Nature Management and Fisheries (*LNV*), the ministry of Housing, Spatial Planning and the Environment (*VROM*), and the Association of Water Boards (*UvW*). The plan encompasses the 1998-2006 period, with occasional glimpses into a more distant future. Previous governmental policy plans were issued in 1968, 1984, and 1989. These strategic policy plans contain the outlines for management at the national level, including (Perdok, 1996):

- attribution of functions to the national surface waters;
- attribution of functions to regional surface waters as far as national interests are involved;
- formulation of objectives concerning water systems including time tables;
- formulation of measures to achieve the objectives set;
- indication of financial, economic and physical consequences.

The 3rd Strategic Water Policy Plan (NW3) from 1989, together with the preceding white paper “Dealing with Water” from 1985, proved to be an important turning point introducing the policy concept of integrated water management according to a water systems approach (Van Hall, 1997a). This concept implies that water managers have to take account of internal functional relations (between quantity and quality aspects of surface and groundwater) and external relations (between water management and other policy sectors, such as environment, spatial planning, and nature management (V&W, 1989). The concept emphasises the need for co-operation and co-ordination between government bodies with strategic or operational water management tasks.

Since the 1980s, a broad consensus has been reached about the appropriateness of the concept of integrated water management. However, integrated water management, or the co-ordination of policies, implies an extensive network of formal and informal interactions between authorities from different administrative levels (Raadschelders & Toonen, 1993).
It requires a change of culture within organisations that are accustomed to act rather independently (van den Berg and van Hall, 1997). Therefore, it may not be expected that the necessary changes will occur in one day. Public authorities will have to go through a learning process, resulting in new administrative structures and relations.

In relation to the water boards, the concept of integrated water management is also known as the concept of the broad perspective (*brede kijk*). It means that in policy and decision making, the responsible authorities should take into account the qualitative and quantitative relations between surface water and groundwater. In addition, they should pay attention to the interrelations between water management and other policy fields, such as spatial planning, and environmental and ecological management. In practice, water boards seem to have different opinions about the scope of the broad perspective (Gilhuis and Menninga, 1996).

The 4th Strategic Water Policy Plan (NW4) builds on the basic principles that were already set out in NW3. The general objective of water management, according to the plan, is to promote a safe and habitable country with healthy and sustainable water systems. Therefore, the policy document focuses on the development of an integrated approach to water systems at various levels of scale, implying that proper management of the lower-level water systems provides a necessary basis for averting problems on a grander scale. NW4 also introduces a new element, namely the increase of the natural resilience of water systems by restoring original dynamic processes. The plan further stresses that the main focus must be on the consequences of possible climate change for water management and on the long-term effects of continuing ground subsidence. Resulting from this, there is more emphasis on flood protection policy than in the previous strategic plans. The other main themes of the plan are water depletion, reduction of emissions from diffuse sources, and the cleaning up of aquatic soils.

2.4.5 International influences

During the last decades the influence of international bodies on national water management has been increasing. Growing concern about water pollution, mostly due to industrial and agricultural activities, has been the biggest impetus for the development of international policies, norms, and measures. Initially, the focus was only on the Rhine, but since 1994 the Meuse is also subject to international agreements.

Perhaps the first international agreement dates back to 1968. The act of Mannheim regulates shipping on the river Rhine and some tributaries. Nearly 100 year later, in 1963, the International Commission for the Protection of the Rhine (ICPR), nowadays called the International Rhine Committee (IRC) was established. The aim of the IRC was to improve the water quality of the Rhine. Later, in 1986, after the Sandoz disaster, the riparian states of the Rhine agreed to the Rhine Action Programme (RAP). According to the plan the Rhine riparian states are committed to further reductions of discharges of priority pollutants aiming at ecological rehabilitation, safe drinking water production and prevention of sediment pollution, and protection of the North Sea. The RAP can also be seen the starting point for ecological rehabilitation. This trend was reinforced with the Ecological Master Plan for the Rhine of 1994, which aims at the return of migratory fish and restoration of the connections between the Rhine and its bordering riparian zones and floodplains (*e.g.* well known nature restoration projects are the *'Gelderse Poort'* and the *'Blauwe Kamer'*). After the floods in Europe in 1993 and 1995, the International Rhine Committee (IRC) became also involved in flood risk management.

The Helsinki Convention of 1992, or the Convention on the Protection and Use of Transboundary Watercourses and International Lakes, has stimulated the conclusion of two treaties on the Meuse. The first agreement concerning the discharge of the Meuse (Charleville-Mézière, 26 April 1994, Tractatenblad 1995, no. 50) mainly contains operational provisions on the allocation of Meuse water between Flanders and The Netherlands. Wallonia, where most of the Meuse water originates from, is not a party to the agreement. The second agreement concerning the protection of the Meuse (Charleville-Mézière, 26 April 1994, Tractatenblad 1994, no. 149) was signed by France, Wallonia, Brussels, Flanders, and The Netherlands. Its aim is to improve water quality in the main stream of the Meuse. To co-ordinate the necessary measures regarding water quality and ecology, an International Commission for the Protection of the Meuse was set up. The Flood Working Group Meuse is concerned with issues of flood defence.

Recent activities of the EU include a proposal for an EU framework directive on water policy (COM(97) 49 def), which is meant to replace most of the existing directives relating to water. At the moment of writing, the Council of Ministers has adopted a common position on the amended proposal, and the next step will be the second reading by the European Parliament. The aim of the proposed directive is:

- to offer an integrated framework for EU water policy;
- to harmonise river basin management at member state level; and
- to improve the protection of surface and groundwater, in particular to reach a 'good water status' in the year 2010.

The framework directive is explicitly based on the river basin approach (Mostert *et al.*, 1998). It requires member states to identify their river basins and assign them to so-called "river basin districts". For each river basin district, member states have to set up appropriate administrative structures. The function of these structures is to co-ordinate and oversee the implementation of the directive in each respective district.

The draft-directive further requires that river basin management (RBM) plans have to be prepared for each river basin district. The core of a RBM plan is a programme of legally binding measures, including basic measures obligatory according to Community, national or local legislation, and additional measures necessary to achieve a "good water status". Moreover, the proposal requires monitoring, an assessment of the environmental impacts of human activities, and an economic analysis of water use in the river basin district. The RBM plans have to be reviewed every six years. The draft RBM plans have to be published at least one year before their entry into force, and interested parties should be given at least six months to comment.

An important element of the proposal is the requirement to recover the costs of water management services from the water users, including polluters. With some exceptions, the costs have to be recovered from households, industry and agriculture.

2.4.6 Trends in institutional development

Since the 1970s, water management policy and its administrative structure has been subject to major changes, and it may be expected that these trends will further evolve in the future. First, there has been a transition from sectoral towards integrated water management, with policy planning as the main instrument. Consequently, the concept of integrated water management has been generally accepted at the strategic level. However, progress in its actual implementation is still lagging behind expectations because the public authorities concerned are still going through a learning process how to co-operate and how to co-ordinate. Chapter 5 tells about the practice of integration of water management. Second, international agreements advocating a river basin approach have increasingly influenced national water management, such as the Rhine Action Programme, the Meuse Treaties and the draft proposal for an EU framework directive on water policy. Third, the complex administrative structure of water management has become more clear-cut with a central position of the water boards in regional and local water management, accompanied by a process of concentration and the establishment of all-in water boards.

2.5 Flood risk management in the Netherlands

2.5.1 Introduction

Flood risk management concerns the protection of the land against the risk of inundation. Because of its geographical position, this has always been a major concern in the Netherlands, It is therefore not amazing that flood risk management has largely influenced the structure of total water management.

The outline of this section is as follows. Sections 2.5.2 deals with the legal framework for flood risk management, and its administrative structure. Section 2.5.3 gives a rather extensive description of the development of flood risk management in the second half of the 20th century, including the roles of the various stakeholders and changing policy approaches. In the Section 2.5.4 and 2.5.5, attention is paid to early warning systems and disaster management in relation to floods. Finally, Section 2.5.5 gives some remarks about trends in the institutional development of flood risk management.

2.5.2 Legal framework and administrative structure for flood risk management

The legal framework for flood risk management is largely similar to the framework for general water management, as described in Section 2.4.2. The most important legislation concerning river dikes and other embankments only entered into force in the last few years, partly in response to the flooding disasters of 1993 and 1995. Table 2.9 provides an overview of the formal legislation relevant for flood risk and disaster management, which will be discussed in more detail in the following sections.

Table 2.9 Overview of formal legislation relevant for flood risk management.

Laws with original titles in Dutch	Laws with titles in English translation
Flood risk management legislation:	Flood risk management legislation:
Waterstaatswet 1900 (Stb. 1900, 176)	Water Administration Act
Deltawet (Stb. 1958, 246)	Delta Act
Deltaschadewet (Stb. 1971, 86)	Delta Damage Compensation Act
Deltawet grote rivieren (Stb. 1995, 210)	Delta Act Large Rivers
Wet op de waterkering (Stb. 1996, 8)	Water Embankment Act
Wet beheer rijkswaterstaatswerken (Stb. 1996, 654)	Act of State Water Authority Operations
Disaster management legislation:	Disaster management legislation:
Rampenwet (Stb. 1985, 88)	Disaster Act
Wet tegemoetkoming schade bij rampen en zware ongevallen (Stb. 1998, 325)	Act on Compensation of Financial Losses due to Disasters and Serious Accidents
Institutional legislation:	Institutional legislation:
Waterschapswet (Stb. 1991, 444)	Water Board Act

Identical to general water management, the legal framework concerning the administrative structure of flood risk management is based on the Constitution and the Water Board Act (*Waterschapswet*). The primary responsibility for dike maintenance and management is in principle in the hands of the water boards. As far as dikes are still under the management of the central government, the present decentralisation tendency will lead to a further transfer of authority to the water boards. Eventually, only a small number of dikes will stay under the management of the central government, because of financial and technical reasons.

The provinces have supervision on the flood risk management performed by the water boards, whereas the central government has the supreme supervision. The central government also plays an important role in conducting technical research and in establishing the national policy concerning flood risk management.

2.5.3 Development of flood risk management

Twentieth century history of river Rhine flood management starts in 1926. By the very end of that year the discharges of the river Rhine had increased to 12,000 $m^3.s^{-1}$ (measured in Lobith, the place where the river Rhine crosses the Dutch border (average flow of the river Rhine is 2,200 $m^3.s^{-1}$ (V&W, 1989, p. 50)). The polder *Land van Maas en*

Waal was inundated as the result of a dike failure, and thousands had to flee (see Figure 3.2). The local water board was alleged for poor maintenance practice. This event led to some marginal improvements of the dike system. Fortunately, in the following years - the Great Depression and the Second World War - high water did not occur. In those days dike maintenance was still financed from taxes based on land ownership in the area of the water board.

1953 was an important landmark for flood risk management in the Netherlands. In February 1953, the sea inundated 20% of the Netherlands, with a death toll of 1800[14]. This disaster was the immediate cause for putting flood risk management high at the national policy agenda in the Netherlands. As a result the so-called Delta Act (*Deltawet*) was passed in 1958. This act encompassed a programme to reduce flood risks from sea surges by dike reinforcements and closing of the river arms in the South-West of the Netherlands (the delta of the Rhine and Meuse rivers). The Delta Act (*Deltawet*) marked that flood protection management had become a national instead of a local concern. The central government paid all the expenses[15].

Until the flooding disaster of 1953, flood risk management was to a large extent in the hands of small water boards with consequently restricted financial resources. The flooding disaster made clear that the protection against flooding was inadequately organised (Van Hall, 1997a). It was decided that it was necessary to start a process of scaling-up of the water boards, because their financial and administrative resources seemed to be insufficient.

At this stage of policy development, it was still necessary to formulate protection standards. In 1960, non-legally binding standards were established concerning the Delta projects, after consultation of the Delta Commission (Van Hall, 1997a). The commission advised to base the protection standards on socially acceptable risks of flooding. For the urban agglomeration of the western part of the Netherlands (*Randstad*), it was advised to reinforce the embankments to such an extent that they could turn high-tide levels which occur on average once in a 10,000 years. For the remaining part of the Netherlands, an inundation risk of once in 4,000 years was thought to be acceptable. Furthermore, the Delta Commission advised to introduce the principle of dike ring areas (*dijkringgebieden*), which implies that dikes (and other water infrastructure) around that area should provide a single level of protection against high water.

A major stakeholder in the development, decision making and execution of the Delta projects was the State Water Management Authority, the powerful government agency responsible for water management at the national level. The envisaged completion of the main Delta works did revive ideas to reclaim the Wadden Sea, the wetlands in the northern part of the Netherlands. Between 1963 and 1969, the Lauwers Sea, a small part of the

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14 In the UK, the same event, a co-inciding storm and an unusual high spring tide, caused the death of 300 people, and led eventually to the construction of the Thames barrier.

15 This might have had consequences for the type of solutions for improving safety that were elaborated. In hindsight, it would have been possible to improve safety by strengthening existing dikes to required levels. However, given the management structure this would have implied that locals had to be involved in design and financing. No literature was found on this hypothesis.

Wadden Sea, was reclaimed. In 1969, far more extensive ideas for reclaiming land were developed into concrete plans by the State Water Management Authority. Flood risk safety was only a minor argument; the plans were defended mainly from economic and demographic point of views[16].

However, environmental groups raised opposition and in the beginning of the seventies the government abandoned its plans to reclaim land. These decisions marked the decreased economic importance of land in an economy where agriculture is becoming less and less important in comparison to industry and services, as well as the end of the State Water Management Authority's monopoly in policy making in water management. These developments are confirmed by later decisions to refrain from reclaiming land in the Lake IJssel (*IJsselmeer)*.

A second major decision that proved the importance of environmental concern in Dutch flood risk management was to build sluices in the dike that closes the Oosterscheldt wetlands. This dike was engineered under the Delta Act (*Deltawet*), and its completion would have meant a tidal estuary (wetland) turning into a fresh water lake. However, in 1974, under the influence of environmental arguments the government decided to allocate funds (about € 2.5 billion[17] (of 1956!)) for building a sluice system in the dike that allowed free tide movements, which could be closed in the event of dangerous tide levels. Works were completed in 1978. In summary, the entry into force of the Delta Act (*Deltawet*), the decision not the reclaim land of the Wadden Sea and the decision to keep the Oosterscheldt open have been turning points in water management (Hisschemöller, 1985).

In 1956, principles were formulated for determining the "safe" height of dikes. The discharge for the Rhine was estimated at 18.000 m^3/s, the so-called design discharge, and the corresponding acceptable risk was set at once in a 3,000 years. Based on these figures, the high water levels were calculated that the dikes should be able to withstand the so-called design water level. These risk standards were agreed on by the Ministry of Transport, Public Works and Water Management (*V&W*), together with the authorities of the Province of *Gelderland* where most of the dikes are located. The risk standards implied that 550 km of dikes should be reinforced, out of 650 km. Subsequently, a dike reinforcement programme was developed. However, the necessary works did not progress very fast: by 1977 works were completed only for a 70 km stretch, while another 30 km of works were partly completed (Commissie Rivierdijken, 1977).

In 1970, a 9,500 $m^3.s^{-1}$ discharge at Lobith led to critical situations on a number of river dike locations. The dike reinforcements that were prompted by this event caused a row; the type of solutions that were chosen were cheap but resulted in destruction of valuable landscapes and heritage, as was the case at the village of Brakel. A highly valued characteristic of villages along the river are houses (*dijkhuizen*) built against the often meandering dikes. In the village of Brakel about 50 of these houses were demolished in order to

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16 In fact, the main argument in favour of inpoldering was the traditional economic motive (land for agriculture).

17 Afterwards it was calculated that the same level of flood risk could be attained by reinforcing existing dikes at a cost of 0,5 billion € (Meurs, 1996).

be able to build a straight, high and broad dike. Public protest rose and the water boards, the authorities that are responsible for the actual works, were highly criticised. Subsequently, plans to continue this type of dike reinforcement were obstructed.

In 1975, in the aftermath of the row about Brakel, the ministry of Transport, Public Works and Water Management (*V&W*) installed the Commission River Embankments, or the Commission Becht after its chairman. The task of the commission was to evaluate the 18,000 $m^3.s^{-1}$ risk limit, and, if necessary to propose new limit values (design criteria), and to indicate the opportunities for improving procedures for public commenting on dike re-engineering. Members of this commission included the director of the *Stichting Natuur en Milieu*, one of the larger NGOs for environmental protection and nature conservation in the Netherlands.

The commission advised to reinforce the dikes in the upper river basin to such an extent that they could turn high water levels that occur once in 1,250 years, instead of once in 3,000 years (Van Hall, 1997a). These water levels are called normative high water levels (*maatgevende hoogwaterstanden*). It was remarkable that this recommendation to apply less stringent standards was not disputed. Furthermore, the commission stated that the necessary level of safety could be achieved by “smart” design - seeking site-specific solutions with new technologies for dike construction and dike improvements - or improvements of the embankments that could well minimise the undesirable effects to landscape, nature, and cultural heritage, the so-called LNC-values. Costs were about 20% higher than the conventional ‘cheap’ methods that were favoured by the water boards. Furthermore, it has to be remarked that the commission took account of the possibility of climate change, however without greenhouse gas connotations.

Subsequently, the recommendations of the Commission Becht were adopted by the national government, and in 1978 the safety standards were officially lowered to once in 1,250 years. However, the implementation of the new policy was far from perfect (Van Roode and Mostert, 1998). Although the State contributed 80% of the direct costs of dike reinforcement projects, the water boards were faced with financial constraints. In addition, they were not accustomed to take LNC-values into account. As a result, public protests rose again, and several lawsuits were started, causing delay in the necessary dike reinforcement works.

As a response to the public protests, the Minister of Transport, Public Works and Water Management (*V&W*) established the Commission Review Basic Principles River Dike Reinforcement, or Commission Boertien, in the early nineties. Similarly to the Commission Becht, its task was to evaluate the basic principles of risk assessment and the dike reinforcement procedure. The commission made the following recommendations (Van Hall, 1997a):

- to differentiate safety norms in low risk areas;
- to conduct an Environmental Impact Assessment (EIA) for every project;
- to apply the concept of smart design.

In 1992, the recommendations of the Commission Boertien were accepted by the central government (TK 1992-1993, 18 106, nr.42). The obligation to conduct an EIA for every dike reinforcement project entered into force on 1 September 1994 (Stb.1994, 540).

But then, a series of flooding events was the impetus for rather drastic changes in flood risk management policy. Around Christmas 1993, there was a riverine flooding in the Meuse valley in the province of Limburg. It was a long lasting flooding, leading to an evacuation of 8,000 people, and a total monetary damage of € 115 million. In February 1994, the ministry of Public Works and Water Management and the provincial authorities of Limburg installed the Commission Flood Disaster River Meuse. This commission, also named Commission Boertien II, was asked to advise how to diminish the risk of flooding in case of future high water levels of the river Meuse. The commission presented that same year an analysis of three different strategies to improve the risk situation. The commission took account of climate change in its considerations to design criteria for evaluating the strategies. The commission recommended (Van Hall, 1997a):

- to deepen the Meuse in Northern and Central Limburg;
- to broaden the Grensmaas, while simultaneously developing nature and landscape values;
- to provide additional protection by the construction of embankments.

In the beginning of 1995 there was again a riverine flooding in the Meuse valley. In addition, sustained and heavy rainfall in the catchment area of the river Rhine resulted in extremely high discharges at Lobith. It was then proved, or believed[18], that on several places the dikes were weak. Apparently, the dike reinforcement works had not progressed at the same pace in each place. Actual dike failure could be prevented by *ad hoc* reinforcements, but situations had become so dangerous according to the responsible authorities, or more specifically the major of the city of Nijmegen, that 250,000 people were to be evacuated from low lying areas at risk.

Since 1995, the process of dike reinforcement has gained momentum. In the previous period, progress was slow because of financial and procedural constraints, and the societal discussions about dike reinforcement. As discussed above, these discussions were not so much about the necessity of the reinforcement works, but rather about the mitigation of the negative impacts on landscape, nature and cultural heritage.

The 1995 event spurred public discussion on priority setting concerning dike maintenance. There were allegations to environmental groups being responsible for the dangerous situation. These groups, serving the interests of landscape, heritage and ecology by interfering in the procedures that are required before starting the actual reinforcement works, were seen as the cause for impediments in embankment works and sloppy maintenance. Environmental groups denied disputing risk standards, and said their interference was for the sake of smart design. However, these allegations did not find much societal support.

In reaction to the floodings in the Meuse valley and the near flooding of the Rhine, the government decided to establish a Delta Plan Large Rivers (*Deltaplan Grote Rivieren*) in

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[18] Actually engineers are not able to predict when a dike failure will occur, since the required knowledge of the materials which constitute the often centuries old dikes are lacking. During the 1995 flood event there was much concern about a crack in the dike near the village of Ochten. During the commotion, fired by the enormous media exposure, it was forgotten that in 1926 during similar high waters the dike also cracked but did not fail (Meurs, 1996).

1995. The Delta Plan aims to speed up the process of river dike reinforcements, and the implementation of the recommendations of the Commission Boertien II (Van Hall, 1997a). The Delta Act Large Rivers *(Deltawet grote rivieren*) created the legal provisions to realise the most urgent projects as fast as possible, the so-called "first tranche". The first tranche concerned the construction and improvement of 151.4 km of river dikes in the upper basin and 148.5 km of embankments in the province of Limburg. The Water Embankment Act (*Wet op de waterkering*) which entered into force in January 1996 contains the procedural rules for the "second tranche", including the reinforcement of 460 km of river dikes, to be finished in 2000. The Delta Act Large Rivers (*Deltawet grote rivieren*) and the Water Embankment Act (*Wet op de waterkering*) both provide examples of "project legislation", a rather new phenomenon in Dutch law. Roughly defined, project legislation includes specific acts for specific projects providing for possibilities to deviate from regular legislation, and leading to a slimming-down of procedures and restricted public participation.

Related to its raison d'être, the Delta Act Large Rivers (*Deltawet grote rivieren*) had a rather limited scope in object and time. It was only applicable to the projects listed in the act itself. Special features of the act include the central role of the implementation plan and the provinces, and the direct involvement of stakeholders. The implementation plan describes the consequences of each dike reinforcement project. Moreover, it clarifies how is taken account of all interests involved, including landscape, nature, cultural heritage, public housing, spatial planning and environment. Appeal was only possible against the decision taken on the implementation plan.

Dike reinforcement plans for the first tranche had to be established by the provinces concerned before 1 January 1997. Although the plans replaced several decisions based on other legislation, they should not be seen as all-in permits (Van Hall, 1997a). One of the most important dispensations concerned the obligation to make an EIA. The slimming-down of procedures resulted in an average project preparation time of a half year instead of six years previously (Kroon, 1997). Practice shows that nearly all projects listed were finished within the time limits set, and that values other than safety were not neglected. During the process, 1,155 ha of land was turned into nature development areas (Kroon, 1997). When the Delta Act Large Rivers (*Deltawet grote rivieren*) was evaluated in 1997, specific attention was paid to the newly introduced procedures in relation to support of public authorities and society in general: the general impression was a favourable one (Driessen and De Gier, 1997).

Since the Delta Act Large Rivers (*Deltawet grote rivieren*) had only a temporary character, it was considered necessary to give a high priority to the establishment of an act dealing on a more structural basis with water embankment projects. A first proposal for such an act had already been introduced to Parliament in 1989, but the work on the proposal did not make good progress. However, after the flooding disaster of 1995, several amendments were made to the proposal and the conclusion of the act was speeded up. The Water Embankment Act (*Wet op de waterkering*) finally entered into force on 15 January 1996.

The Water Embankment Act aims to guarantee a certain level of protection against flood risks. It introduces new concepts, such as outside water *(buitenwater*), dike ring areas (*dijkringen*) and primary embankments (*primaire dijken*). According to the act, a dike ring area should be protected against flood risks by a system of primary embankments. In an annex to the act, the dike ring areas are listed in combination with safety norms. These safety norms are based on flood risks in relation to high water levels. In the future, these safety norms will be expressed in a different form, namely as the mean flood risk a year. To this end, flood risks will be established for each dike ring area.

As was already stated above, the Water Embankment Act (*Wet op de waterkering*) provides the prevailing procedure for dike reinforcement works. In case of a planned construction of primary embankments or their modifications, the regional water board has to establish a project plan. These project plans should contain the necessary project provisions as well as mitigating and compensating measures for damage done. Moreover, the plan should clarify which measures will be taken to promote the values of landscape, nature, and cultural heritage, the so-called LNC-values. The water boards are obliged to involve provincial and municipal authorities in the plan preparations. These plans have to be approved by the province involved.

Unlike the Delta Act Large Rivers (*Deltawet grote rivieren*), the Water Embankment Act (*Wet op de waterkering*) does not give dispensation of regulations established in other legislation. The act only gives several provisions to shorten procedures. It has been estimated that a procedure based on this act will take on average two and a half years (Van Hall, 1997a). However, in one of the progress reports about the Delta Plan Large Rivers *(Deltaplan Grote Rivieren*), it was acknowledged that several projects had become subject to delay caused by EIA-procedures and changed insights on appropriate measures (TK 1997/98, 18 106, no. 88-89).

The Water Embankment Act (*Wet op de waterkering*) also provides the legal basis to guarantee that after the realisation of the dike reinforcement works the achieved level of protection against flooding will be maintained in the future. To this end, the water boards have to report to the provinces about the state of the primary embankments every five years. The provinces have the same obligation towards the Minister of Transport, Public Works and Water Management (*V&W*).

According to the Water Embankment Act (*Wet op de waterkering*), the Minister of Transport, Public Works and Water Management (*V&W*) must establish technical guidelines concerning design, management, maintenance, and assessment methods of primary embankments. In practice these tasks are performed by the Technical Advisory Commission Embankments (*Technische Adviescommissie voor de Waterkeringen*). Recently, this commission set up a research programme to develop a calculation methodology to establish flood risks for dike ring areas.

Since the financial agreement between the central government and the provinces, the maintenance and reinforcement of primary embankments is financially supported by the provinces. With regard to maintenance, water boards and provinces have to negotiate about the division of costs. With regard to reinforcement, an agreement has been reached between the joint provinces (*InterProvinciaal Overleg*) and the union of water boards (*Unie van Waterschappen*). According to the agreement, the provinces pay 72% of the once-only costs of dike reinforcement works resulting in the meeting of safety norms. This means that adaptations to non-sudden events, such as climate change, are considered to be maintenance costs (van den Berg and van Hall, 1997).

During the discussions in Parliament on the Water Embankment Act (*Wet op de Waterkering*), the Minister of Transport, Public Works and Water Management (*V&W*) stated that after 2000 measures to lower high water levels should have the first priority, and that dike reinforcement should be considered only as a final option because of the huge costs and decreasing social acceptance (Van Hall, 1997a). Subsequently, in 1996, the minister, in co-operation with her colleague responsible for environment, introduced a policy line with the aim of increasing the storage and discharge capacity of the large rivers (*Ruimte voor de rivier*). The policy includes guidelines to assess whether activities are allowed in the winter bed of rivers, and under what conditions. Non-river bound activities, such as recreation and house building, are only allowed in case of considerable social importance. In addition, they should not hinder the future enlargement of the discharge capacity. Thus, the perspective for the 21st century is to create broader and deeper rivers, and to lower forelands and polders as to make inundation possible. However, it is doubted whether the guidelines include any new policy, since the Rivers Act (*Rivierenwet*) of 1908 already gave strict regulations about activities in the winter bed, which seemed to be “forgotten” (Van Roode and Mostert, 1998). Anyway, the new guidelines have been the reason to cancel already planned activities, such as house-building and industrial activities.

To prepare the implementation of the new strategy, the State Water Management Agency is presently making inventories of measures that will create additional discharge capacity. With this, a normative high water level of 16,000 m3, and eventually of 18,000 m3, is taken into account (Ploeger and Du Manoir-Schutte, 2000). In addition, it is foreseen that a few polders and other areas will be reserved for temporary storage of water during times of exceptional high discharges. Several stakeholders are involved in the preparation process, including environmental NGOs and the Association of Dutch River Municipalities. The state agency will report to the Minister of Transport, Public Works and Water Management (*V&W*) in 2000, and it is aimed to execute the necessary works in the period from 2001 to 2015. Simultaneously, the Committee Water Management 21st century (*Commissie Waterbeheer 21ste eeuw*), which was recently established by the Sate Secretary of the ministry of Transport, Public Works and Water Management (*V&W*), is preparing an advice to the government on several issues in relation to water management, including measures to create space for the major rivers (Ploeger and Du Manoir-Schutte, 2000).

The strategic policy plan NW4 already observed that adequate legal instruments to create space for the rivers are missing and that there is a need for an “umbrella project decision” and executive decision-making competencies. For the time being, however, the government refrains from issuing a new piece of “project legislation”. Presently, it is under consideration to declare the future State Government project procedure (*Rijksprojectenprocedure*), which will be part of the Act on Spatial Planning (*Wet op de ruimtelijke ordening*), applicable to large scale projects in the catchment areas of the major rivers. According to the proposal, specific project ministers will be designated to have the control over the decision-making process of entire projects, and a special feature of the procedure will be its direct effect on municipal spatial planning (*bestemmingsplan*).

A side-effect of the realisation of “river space projects” will be the release of huge amounts of contaminated soil material (Ploeger and Du Manoir-Schutte, 2000). It is estimated that 20% of this sediment will be heavily polluted. Therefore, it will be necessary to construct large-scale storage depots. This will not only lead to high extra costs - the government has earmarked for this more than € 400,000 up to 2010 - but in some regions the absence of any prospect of sufficient storage capacity will be a problem (V&W, 1998).

Anticipating on this change in policy priorities, a small number of projects with the aim of increasing discharge capacity have been started, substituting already planned dike reinforcement works. In several of these cases, farmers and other inhabitants have offered opposition, because they perceive the new policy line as a violation of their property rights.

Since 1995, flood risk management has also been put on the agenda in international forums. In 1995, the EU Council of Environment Ministers signed the Declaration of Arles, stating that action plans on flood protection should be prepared for the Rhine and the Meuse. Both action plans, -one prepared by the International Rhine Committee, the other by the Flood Working Group of the Meuse-, have been presented in 1998. They aim to reduce the risk of loss and damage by lowering high water levels, improving prediction and warning systems, and raising awareness of the possibilities and consequences of floods. While reducing flood risks the plans also aims to improve the ecological values of the rivers Rhine and Meuse. More specifically, the objectives of the Rhine Flood Action Plan are (Van Roode and Mostert, 1998):

- to stabilise the damage potential by 2005, and to decrease it with 10% by 2020;
- to lower high water levels up to 30 cm in 2005 and up to 70 cm in 2020;
- to improve early flood warning;
- to increase awareness.

Another international initiative was taken by the ministers of spatial planning of the Rhine and Meuse countries (Van Roode and Mostert, 1998). The so-called Working Group Strasbourg aims to develop a plan to solve high water problems by spatial measures in the whole catchment area. At present, the countries involved are making inventories of possible measures and their effects.

2.5.4 Early warning systems

Warning at an early stage enables people to take necessary precautions and preparations to limit the effects of a flooding as far as possible. In the Netherlands, the minister of V&W has the final responsibility for the dissemination of information about water levels and the warning of the responsible authorities in case of alarming high water levels.

The expected discharges of the rivers Rhine and Meuse are monitored by the National Institute for Inland Water Management and Waste Water Treatment (*RIZA*), an operational department of the ministry of V&W, in co-operation with the responsible agencies from the other riparian countries. Hence, *RIZA*'s effectiveness is premised on optimal communication arrangements with those agencies (Rosenthal *et al.*, 1997).

When the figures come in from the neighbouring countries, calculations and estimates are passed on by RIZA to the various regional departments of the State Water Management Authority (*Rijkswaterstaat*). Subsequently, the regional departments produce estimates for each municipality along the river, including the maximum water level and peak-level times. In case high water is expected, *Rijkswaterstaat* informs regional fire brigades and a selection of municipalities. *Rijkswaterstaat*'s predictions for the river Meuse are valid for a maximum period of 12 hours, those for the Rhine have a validity of 48 hours (Rosenthal *et al*., 1997). The entire warning and dissemination process is co-ordinated at *Rijkswaterstaat*'s headquarters in the Hague.

A few days before the Meuse flooding in 1993, the Department Limburg of *Rijkswaterstaat* sent out an early warning signal, withdrew it two days later and had to send out a new warning signal shortly after (Rosenthal *et al*, 1997). Communication with the Belgian authorities passed off with difficulty. A further complication were the 12-hour forecasts of *Rijkswaterstaat*. According to *Rijkswaterstaat*'s specialists longer-term forecasts would lead to unacceptable margins of error. In addition, municipal authorities perceived *Rijkswaterstaat*'s forecasts as inconsistent. Soon after the first floods, *Rijkswaterstaat* issued another early warning signal, but this turned out to be a false alarm.

Two years later, towards the end of January 1995, *Rijkswaterstaat* made again an alarming prognosis about the water level of the Meuse. It seemed the water would reach a level exceeding the one of 1993. Whereas in 1993 forecasting and response authorities did not initiate action until extreme high water levels were reached, in 1995 they did not wait for that to happen but took a more pro-active attitude (Rosenthal *et al.*, 1997). Also in contrast to 1993, *Rijkswaterstaat* was prepared to issue “unofficial” predictions that contained a much wider time horizon than the official maximum of 12 hours.

With regard to the near-flooding situation in the Rhine basin in 1995, the water boards in the region and the Department Oost-Nederland of *Rijkswaterstaat* had initially different opinions about the seriousness of the situation. The water boards were of the opinion that the prognosis of *Rijkswaterstaat* was too optimistic, which was later admitted by the latter. At a later stage there were problems in communication between *Rijkswaterstaat* and the authorities responsible for disaster management. The authorities asked for more long-range forecasts and specific policy-oriented advice, but *Rijkswaterstaat* held on to its own standards and procedures.

In reaction to the miscommunication and lack of longer-term forecasts in 1993 and 1995, the Rhine Action Plan on Flood Defence aims to improve the system of flood forecasting (ICPR, 1998). In the short term this should be realised by international co-operation. Targets in the longer term include the prolonging of the forecasting period by 50% by the year 2000, and by 100% by the year 2005 (reference year 1995).

2.5.5 Disaster management

In the Netherlands disaster planning, management and response is outlined in the Disaster Act (*Rampenwet*) of 1985. According to this act, a disaster - hydrological disasters being just one type of disaster- is an event that puts life at risk for a large number of people, or affects material interests severely, and requires mitigation activities of various nature.

The Dutch disaster management structure is characterised by different levels of government being involved, *i.e.* central, provincial and local level (Rosenthal *et al*., 1997). At the local level, the mayor is the head of the disaster response organisation. At the provincial and central level the responsible persons are respectively the Royal Commissioner (head of province) and the Minister of Interior Affairs. Other actors that play a role in disaster response are the fire brigade, the army, the police, the first aid assistance (*EHBO*), the hospital transport services (*GGD*), and the Red Cross. Evacuation decisions are in principle in the hands of the mayor, but the Minister of Interior Affairs may take over the competence to evacuate, if deemed necessary.

The question may be raised how regulations concerning the authority of water boards relate to regulations in the Disaster Act (*Rampenwet*). In the first place, it is important to realise that the act is only applicable when an event falls under the legal definition of a disaster. In case a disaster occurs, the water boards keep their regular authority, but they have to accept that other authorities, such as mayors, the Royal Commissioner, and the Minister of Interior Affairs, have additional powers.

The Disaster Act (*Rampenwet*) requires municipal authorities to develop contingency plans. These plans should address each hazard that exists in the municipality (*e.g.* flooding, and explosions), and must include the organisational structure, the emergency management activities and a list of all agencies and/or authorities that should be involved in emergency activities. Local fire chiefs have the primary operational responsibility in the activities on site.

To inform the water boards on disaster management, the union of water boards (*Unie van Waterschappen*) has established a paper outlining the necessary elements of dike security plans. The union has also stressed the importance of disaster management, and gives the advice to municipalities to discuss their disaster management plans with the water boards involved.

The phenomenon of a disaster subculture often plays an important role in taking action or not by authorities and citizens, but it is not easy to predict what the influence is of having experience with disasters. A disaster subculture is defined as a complex interconnecting set of meanings, norms, values, organisational arrangements and technological appurtenances which have emerged in response to repeated disaster threat and impact (Duin *et al.*, 1995).

The flooding in the province of *Limburg* in 1993 caused in general only minor changes in the disaster response organisation (Duin *et al.*, 1995). However, the region of *Nijmegen* was the big exception. In 1994, this region initiated the drafting of a model-contingency plan "Flooding and Dike Failure" for the province of *Gelderland*. Subsequently, the plan needed to be elaborated into concrete measures for each specific region within the province. The region of *Nijmegen* was the first to accomplish this task, just in time before the flooding of 1995.

The contingency plan of *Nijmegen* played an important role in the response to the flooding disaster in 1995. It may even be stated that without the plan an evacuation of citizens would not have taken place, because nobody would have known how to react. In the previous period, there was almost no communication between water boards, authorities and social workers (Duin *et al.*, 1995). The mayor of *Nijmegen*, strongly influenced by the responsible water board *Polderdistrict Groot Maas en Waal*, was the first to decide that evacuation of citizens was necessary. Several mayors of other municipalities followed his decision. Research shows that, despite the fact that the dikes in the province of *Gelderland* did not give way, nearly all respondents (88%) were of the opinion that the evacuation was an appropriate measure (Duin *et al.*, 1995).

In the Netherlands, only very recently legal arrangements were made to provide damage compensation in case of floods, earthquakes and other disasters or accidents. The Act on Compensation of Financial Losses due to Disasters and Serious Accidents (*Wet tegemoetkoming schade bij rampen*) entered into force in June 1998. However, since 1799 (Napoleon) the national government has supported, on an *ad-hoc* basis, individuals and firms that suffered from damage due to floods (actual damage from water or damage because of the business interruption at evacuation of areas at risk). Support was distributed by the Disaster Fund (*RampenFonds*), which was established by charity organisations together with the government. Not all damage was covered, in the 1993 case (Meuse flooding) deductibles were established (this started after the large flooding in 1809). After the floods of 1995, the government paid € 165 million to compensate for the financial damage (NRC, 16 September 1998). The households subject to evacuation received a compensation of € 225 each (Duin *et al.*, 1995).

2.5.6 Trends in institutional development

In the last 45 years, flood risk management in the Netherlands has gone through several stages, and has increasingly developed into a policy field with a high profile. Policy changes, often induced by flooding or near-flooding disasters, and usually supported by the work of advisory commissions, included the administrative structure of flood risk management, financial aspects, safety standards, procedures, and the policy focus. Furthermore, flood risk management and legislation became increasingly interrelated, resulting in the establishment of several new acts.

Originally, the focus of flood risk management was restricted to safety issues, but largely due to public pressure a more integrated policy approach was adopted, including values of landscape, nature, and cultural heritage. In addition, planning and decision making processes have become more open and consensus-oriented, involving a variety of stakeholders. Recently, the priority in flood risk management has changed from dike reinforcement works to the increase of discharge capacity eventually having repercussions for spatial planning. Due to the floods of 1993 and 1995, flood risk management also got a stepped-up international dimension, resulting in agreements on transboundary measures focusing on an increase of discharge capacity.

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3. The evolution of acceptable risk

Alexander A. Olsthoorn[19]

3.1 Introduction

Being exposed to dangers is a human condition. Pursuing strategies to reduce these dangers is the human activity in response to this condition. We assume that the design of these strategies implies some consideration of the trade off between the costs of a possible strategy and the associated reductions of the risk. Whatever strategy eventually decided on, there will always remain a 'residual' risk[20]. This residual risk can be viewed as the acceptable (or tolerable) risk, or, in its reverse form, as a (sort of) safety standard.

This chapter assumes that the analysis of the history of acceptable risk can add to the analysis of the dynamics of institutional change (the object of the SIRCH research). We will analyse the history under the assumption that the latter is the result of random events - meteorological events - against the background of four societal trends: integration, democratisation, naturisation and rescaling (*e.g.* internationalisation). We concentrate on decision making at the governmental level, while attempting to identify the influence of 'local' interests on governmental decision making.

Figure 3.1 Dike collapse during 1953 catastrophe. Source: Huisman, 1998.

The story starts in 1953, the year of the catastrophic sea flood. The political response to this event was that National government took responsibility for flood safety, hitherto in the hands of local bodies (*Waterschappen*). An advisory body, the Delta committee, played a principal role in the design of flood safety policy. The material outcome was the Delta project, a series of flood safety works including dikes to close-off estuarine areas from the sea. Much of the committee's activities regarded the grand design of these works, the key question being what safety to strive for. The initial - traditional - design

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[20] The residual risk can/will also be subject to management, contingency planning for instance, or/and insurance.

rule was that flood defences were required to withstand the 1953 type of storm surges, with a safety margin. However, a new element was the committee commissioning an economic analysis of the Delta project, using 'methodologies developed in decision theory and operational research' (Dantzig, 1960). At that time 'decision theory' and 'operations research' were quite new for the Netherlands. These methods required insight in the probabilities of high water events and statistics on stocks-at-risk, bodies of knowledge not (formally) used earlier in flood risk management. So while until the fifties the main principle in flood risk management was that a certain disaster would not to be happen again, the sixties saw the introduction of the cost-benefit discourse.

In flood risk management the key indicator that encompasses the results of such cost-benefit trade-off has become a return period of high discharges that flood defence could manage. Such indicator says that a flood defence policy is to cope with a once-in-x year river discharge event, it is an indicator for the risk that a flood would occur. This indicator reflects societal considerations of different interests and trade-offs.

The Sections 3.2, 3.3 and 3.4 summarise the events over the past fifty year, making a distinction between the periods 1953-1974, 1974-1993 and the nineties. Section 3.5 discusses and concludes.

3.2 1953 – 1974: A slow start and a confusing end

The period 1953-1974 starts[21] with the large tidal flood disaster that pushed flood control risk policy into the top of the political agenda. The period ends with the parliament adopting the motion Albers 21/02/74, asking the minister of Transport, Public Works and Water Management, to better take into account the interests of landscape, of cultural heritage and of nature, when judging request for subsidies for dike works.

The disastrous flood from the sea prompted 'modern' flood risk policy making in 1953. We call this modern since the Delta committee performed 'scientific' risk analysis by applying statistical techniques and hydraulic models to estimate the chances on extreme sea levels, while until that moment dike engineers had used the historically highest water level as the primary guideline. A second new element was the use of 'methodologies developed in decision theory and operational research' in the economic analysis of the Delta project (van Dantzig, 1960). At that time 'decision theory' and 'operations research' were quite new methodologies for the Netherlands.

The results of this analysis – actually a cost-benefit analysis - were used to establish engineering guidelines for dike heights. The analysis distinguished different geographical areas with different flood risks and different stocks-at- risk. As a consequence guidelines were area specific. For the Western-central part of the Netherlands, the most populated and built-up area of the Netherlands, dike-height would have to be equal with a sea level that supposedly would occur once in 10,000 year. For the rest of the Netherlands at risk to sea surges this 'risk level' was once in 4,000 year. These values were politically agreed on, but not codified in law.

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21 Langen and Tol (2000) summarise the preceding long history of the river Rhine and institutions involved in water safety management.

It should be noted that dike height is not the main criterion for determining flood safety. The strength of the dike and of other water retaining structures (*e.g.* sluices) is actually even more important to the flood safety (TAW, 2000). Disasters occur from dikes collapsing before being overtopped.

The activities of the Delta committee mark the increasing involvement of the science community and scientific methods in risk-policy making. This is interesting in the light of current analysis of policy making and policy learning that distinguishes scientific knowledge as a separate element in policy construction.

‘Modern’ policy making that specifically addresses flood risk posed by rivers, started in 1956. In that year the Gelderland Provincial government (*Gedeputeerde Staten*, GS) asked Minister Algera of Transport, Public Works and Water Management which peak discharge level would be appropriate to be used as a starting point for engineering ‘safe’ dikes. In other words the Gelderland authorities asked the National government to establish a guideline for acceptable risk, in other words a guideline – highest water level to reckon with - for engineering flood safety works. Next to the 1953-events inspired concern about flood risk there might have been a special reason for GS for taking an initiative for formulating a flood risk policy. In those years a scheme for land consolidation (*ruilverkaveling*) was carried out, under the responsibility of provincial authorities. The inhabitants of polders had been asked to move from traditionally relatively safe places near dikes and on higher grounds to low lying places, increasing their exposure to flood risks (Rossum, 1975).

Figure 3.2 The last serious flooding of a polder along the rivers occurred in 1926
Source: Middelkoop, 1998.

The minister indicated that the guideline for acceptable risk that the province of Gelderland had asked for, was to be based on a peak discharge of the river Rhine at the German border of 18.000 m^3/s. This value corresponds with a water level of 17.6 m NAP[22]. According to the estimate by Government experts (public servants of *Rijkswaterstaat*) such peak flow would occur once in every 3,000 year. This value was established from a statistical extrapolation of historical discharge data at Lobith and took into account the sum of measured maximum discharges upstream in the river Rhine and its tributaries, assuming a chance that these discharge could occur simultaneously. Earlier, the determination of the required heights of dikes was based on the historically highest known water levels[23]. The minister noted in his letter to GS that he did not know the financial consequences of adopting this guideline, and, therefore recommended applying this guideline while considering the practicalities and circumstances.

The estimate was that this guideline implied that 550 km dikes, out of 650 km in total, required strengthening. However, works were slow to start and in the beginning of the seventies only 50–70 km of the intended works were completed.

Several reasons may explain this slow rate of progress. A major reason was lack of financial resources. The water boards, responsible for dike maintenance works, are dependent on provincial government and in particular on National government for finance. National funds however were mainly used for sea defences (the Delta works). An additional financial complication was due to the *dijkhuizen*. *Dijkhuizen* are dwellings built closely adjacent to the dikes, many being in bad condition in the fifties. These were often categorised as slums. These dwellings were obstacles for dike improvements that were thought to be overcome by demolishing only. So there was a question “who would have to pay for compensation of demolished houses?” In 1965, the *Gedeputeerde Staten* (GS)- legally responsible for providing safety for its inhabitants - dike heights and dike integrity – took an initiative to reinforce embankments, only to be rejected by the *Provinciale Staten* (the province’s parliament) for insufficient financial backing.

Procedural bottlenecks and disputes also contributed to the slowness. For instance the dike improvement issue linked to the public housing policy of the fifties. The then housing policy included programmes to remove slum houses (*e.g. dijkhuizen)* and also a scheme for compensation payments and the like. So when *dijkhuizen* were involved there were questions about who should pay for compensation. The 1965 initiative of GS was also rejected for fear of legal disputes, from the province entering the jurisdiction of the water boards.

The sixties and seventies saw also the rise of environmentalism. In sea flood management the discussion on the environmental impacts of the Delta works and the damming of the estuaries in the province of Zeeland had been intense, and successful in terms of adjusted flood defences (moveable dams). The environment, and landscape and cultural heritage, became an issue in the discussion on river dike works. This relates to the fact that river landscapes always have been a highly valued element of Dutch culture, shown

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[22] *Nieuw Amsterdams Peil* (NAP), The reference point for measuring water levels (and geographical horizon).

[23] The peak discharge at Lobith is actually not the only determining factor. Ice blocking in the rivers used to be a principle cause of floods. The possibility of ice blocking was analysed in recent studies (Becht, 1974, Boertien, 1993) but not found a major issue. Therefore we do not refer to this phenomenon further.

in many paintings and literature. One of the country's most famous poems -*'Herinnering aan Holland'*[24] by H. Marsman - is on the river landscape. The *dijkhuizen* constitute one on the mostly liked elements in the landscape. This was recognised early. In the fifties, an advocate (Korf, 1959) of dwelling-free dikes considered the possibility to conserve a few of those *dijkhuizen* because of their cultural heritage value.

In the fifties and sixties, high river discharges failed to occur. In 1970, however, a high, but not dangerous, discharge (9500 m^3/s) revived the discussion on dike strengthening activities and questions were asked in parliament about the very slow pace dike reinforcement. The minister argued that calculation of the required dike heights was a time-consuming but necessary part of the procedures[25] and activities continued to proceed slowly. Change in technology (of computing) appears thus also to be a factor contributing to explaining rates of changes.

Then, in 1974, new stakeholders entered the field. In the village of Brakel about 50 *dijkhuizen* had been demolished in order to build an ugly new stretch of dike. A public row followed after loud protests of local action groups and national environmental NGOs. To them this dike reinforcement project proved the inability and unwillingness of the authorities that were responsible for dike management to take interest in nature, landscape and cultural heritage. These voices were heard in the National parliament and the motion Albers was adopted and further works were stopped. The Brakel row may be regarded as a marking point in trends with respect to democratisation - increasing influence of stakeholders in decision making - and to naturisation - the rise of nature (and cultural heritage and landscape) as an highly valued interest. The time had come to reconsider the ways how different interests should come to expression in concrete dike reinforcement works.

3.3 1974 – 1993: How to integrate and decentralise?

So, since the normative and procedural principles with respect to safety are constitutionally determined at a national level, national level decision making was to resolve the dead lock. The motion Albers in the national parliament prompted the minister of V&W to install the *commissie rivierdijken*, better known as the Committee Becht (after the name of its chairman). This committee was asked by the minister to advise on:

- a possible adjustment of the 18000 m^3/s flow (the normative design level derived from the guideline established in 1956, and then supposed to have a once in 3000 year return period);
- the possibilities to optimise existing procedure for public participation in decision making (*inspraakmogelijkheden*).

The area to advise on was confined to those riverine areas under influence of only river (not effects of sea tide). In the parliament discussion at the installation of the committee,

24 Translated as 'Reminiscence of Holland'.

25 In the period 1956-1963 *Rijkswaterstaat* had to estimate discharge levels by time consuming calculations by hand. Also electrical analogue models have been used. The availability of powerful digital computers in the eighties made it possible to operate models that capture more detail and are able to produce results with low uncertainties in a short time.

the minister mentioned not to want loosening flood safety standards (once in 3000 year), but, on the other hand, he gave the commission room for reconsideration.

Three member of this committee were professionals in water management (high level civil servants from administrative bodies engaged in water management), two were authorities in the area of physical planning and land use, while the director of the NGO *Natuur en Milieu* (Nature and Environment), represented the interest of nature. Soon after commencing its activities, the committee decided to include design of embankments in its considerations, since the committee recognised the importance of the actual design of dike improvements for the eventual outcome of the works in terms of landscape and nature. For its approach, the committee said it adopted in principle a cost benefit approach, while recognising severe limitations due to lack of information (on both the actual risk reduction (benefits) and on the actual costs).

Starting point of the considerations is an assumption on the statistics of the discharge (m^3/s) at Lobith, where the river Rhine enters the Netherlands. On advice of the *Mathematisch centrum* (the national academic institute for mathematics) the committee extrapolated empirical data on discharge frequencies at Lobith (1901-1975) into low frequencies by assuming an exponential frequency distribution. (in that period the highest discharge measured was 13000 m^3/s, in 1926). For three cases (peak discharges) the committee had made calculated peak discharge water levels down stream, and could then assess the total length of dike requiring strengthening, assuming no change in flow capacities of down stream river branches[26]. Table 3.1 summarises the results.

Table 3.1 Discharge frequencies and water levels (river Rhine at Lobith) adopted by the Becht Committee.

Frequency	Discharge (m^3/sec)	Water level at Lobith (meter above NAP)	Total length (km) of embankments requiring reinforcement
1/3333	18000	18.1	450
1/1250	16500	17.9	390
1/500	15200	17.7	310

For the three peak discharges shown in Table 3.1 the committee had Rijkswaterstaat estimate design discharge levels (MHWs) along the river courses down stream from Lobith[27]. Next, four case studies were carried out: studies of the possibilities to improve four stretches of dikes to safety standards derived from the pertinent peak discharge level. The cases were selected on the clear difficulties that nature and cultural heritage would pose to improvements. The committee did not investigate the options of modifying the downstream Lobith water channels, for instance the possibility to direct more water into the river IJssel. The argument was that there was not enough time to study this option. Neither did the commission consider the possibilities of using overflows for storage of peak flows as a means to control flood risks.

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[26] Dredging of river beds, increasing a river’s discharge capacity, would reduce the need for dike strengthening, for instance.

[27] In those days still a time consuming procedure.

Much of the effort of the studies were directed at the design and engineering of dikes with a view on minimising the effects of dike strengthening on landscape, nature and cultural heritage (LNC values). And a result of the study was the concept of 'smart' design: the possibility of designing dike strengthening in such way that the impact on landscape, nature and cultural heritage is limited, at some costs.

In its final report (1977) the committee advised to accept the once in 1250 year risk as the guideline for dike reinforcement works, and to apply the concept of "smart" design with its associated increased (about 20%) costs. Its the recommendations were accepted all parties - including the environmental NGOs - in the following year.

The scope of the activity of the Becht committee had its limitations:

- geographically it was limited to the province of Gelderland;
- possible measures targeted at increasing the discharge capacity of the river beds were not considered (for lack of research capacity);
- no distinction was made between different dike ring areas. This means that the differences in the 'stocks-at-risk' per dike ring area were not recognised. If these had been taken account of the overall outcome could well have been different. We note that the *Unie van Waterschappen* (the Association of water boards), in its comments on the interim report of the committee had explicitly rejected differentiation in risk (and the 1/500 risk guideline, and the option of overflows for storage of the top of river waves).

Another limitation proved to be that the recommended administrative procedures and procedures for financing were not effective in practice. This was one of the reasons that dike strengthening works kept to stall in the eighties. Other reasons were: (*i*) a certain reluctance among authorities (water boards) to adopt the wish to give more weight to the interests of nature, landscape and cultural heritage (Boertien 1, 1993), (*ii*) government budget cuts - especially in the eighties -that limited the funding of the programmes, and (*iii*) lack of research capacity to perform studies. So, in the period 1979-1984, the periodical *Waterschapsbelangen* does not report on dike strengthening issues, except for a note in 1982, that the National government has cut budgets.

In the middle of the eighties discussions started again, initiated by new calculation[28]s of peak discharges downstream, in the transition area between river and sea. One of the issues to surface in the discussions for acceptable risk in these areas was 'what risk to accept? The extreme options were the once-in-4000-year safety standard for inundation from the sea or the once-in-1250-year standard for river floods. This logical question may have provide the ground for later acceptance of more refined differentiation of acceptable risk.

Also in the middle of the eighties studies were started to design a Water Embankment Act (*Wet op de Waterkering).* This act – to be accepted only in 1996 - is a piece of law in a series of laws pertaining to the various aspects of water management (*e.g.* water quality, institutional aspects (water boards), groundwater act). A notable element in this act is the introduction of the concept of dike rings: the dike ring philosophy. It says that the object of flood safety policy should be areas, rather than dikes. It is interesting to read the

[28] Facilitate by the advance of digital computers.

minutes of a meeting (6/4/1989) of the parliament's standing committee for water management with mrs. Smit-Kroes, then minister of V&W. It appears that the dike ring philosophy - implying the possibility of differences of acceptable risk over dike ring areas - is more or less accepted among politicians, although some warning is given that 'in the field' this idea is not generally accepted. This reflects the earlier point of view to the *Unie van Waterschappen* (Association of Water boards) rejecting differentiation in risks in their terms of reference for the Becht committee (see above). A circumstance that may have facilitated accepting the dike ring approach was the then political importance of "deregulation". In the discussions deregulation was mentioned. This idea actually supports the dike ring philosophy (risks based on cost-benefit analysis, accepting the possibility of different inundation frequencies), since it implies that decision making on acceptable risk should not be to rigid. However, the act was only to be passed in 1996, after a series of important hydrological events.

For better understanding developments it is noted that in the eighties water management policy was undergoing major changes. A turning point has been *Rijkswaterstaat*'s white paper "*Omgaan met Water"* (Dealing with water) which puts integration and multi-objective decision making forward as major principles. In addition - and in relation - environment and nature are identified as major interests that have to be taken account of in policy making. In sum, in policy making community, the concept of the necessity to take account of different interest in designing policy wins ground.

However, although at strategic level things started to change, dike reinforcing came to a halt. A deadlock evolved, to which an antagonism between water boards and local action groups contributed greatly. Locals – *e.g.* united in action groups such as *Redt ons Rivierenlandschap (*Save our river landscape*)* - were reluctant to accept changes and antagonistic towards water boards, and used all legal possibilities to put up resistance. For instance, they won, before the European court, their case against the water boards for dike strengthening projects to be subject to Environmental Impact Analysis.

3.4 The nineties: How to cope with uncertainties?

Stalling progress in the implementation of flood policy, new ideas for water management and flood events in 1993 and 1995 accelerated developments in the nineties. In 1991 the parliament asks the government (motion Everdijk, 18/4/1991) to give a higher priority to strengthening of river dikes, asking to take into account as much as possible the interests of nature and landscape. In response to this motion and in response to a more general public discussion on the principles for river dike strengthening, the minister installed – fifteen years after 'Becht' - the committee '*Toetsing uitgangspunten rivierdijkversterkingen'* (the committee Boertien, named after its chairman[29]). This committee was to supervise a large study that would address three questions (Letter to the parliament 24/07/1992):

[29] Boertien was a former head (*Gouverneur-generaal* of the province of Limburg). The three other members were H.H. de Boois (former member of the parliament), E.H.T.M. Nijpels, then major of the city of the city of Breda and former minister of environment and physical planning, and prof. M.J. Vroom, then professor in landscape architecture at the Wageningen Agricultural University.

- Do the considerations underlying the selection of the safety standards for the river dikes contain any elements that have changed to such an extent that this might give rise to a different choice?
- Are there any new technological /scientific insights that may result in different calculation results?
- Have new elements come up in recent commentaries that are outside the scope of the previous two questions, but that might likewise result in a different choice or other calculation results?

The answers to all three questions were all yes, grossly speaking (Min V&W, 1993).

However, the actual policy analysis (see below), did not take into account the possible hydrological effects of climate change and of land use in upstream river basins were not considered. Climate change was not considered because of a lack in agreement in a most plausible scenario, while lack of information on land use in the non-Dutch parts of the river basins prohibited analysis, according to the study. The actual policy variables were: (*i*) safety levels (overtopping frequencies); (*ii*) sophistication of dike works (*e.g.* moveable dams) and (*iii*) works to enlarge discharge capacity of floodplains (*e.g.* excavation of floodplains).

The results and approach of the otherwise extensive studies are summarised in the exemplary Table 3.2, which presents one of the results of the cost-benefit analysis that were performed (Walker *et al*., 1993). Three 'policies' are analysed only, differing in safety level. (Enlarging discharge capacity is not a degree of freedom in the table.) The data on peak discharges reflect the assumptions on the probability distribution of peak discharges. The actual works, to be carried out in order to comply with the safety levels are based on these peak discharges (at the location where the rivers enter the Netherlands). The works are restricted to the dikes. They refer to dike reinforcement, to raising dike heights or to both.

The first row presents the summed lengths of dike stretches[30] that would have to be dealt with under each safety level. The data in the row 'personal risk'- referring to a number of victims of a catastrophic flood - is not estimated (said to be not possible), except for an assessment of the relative number of victims. An estimate of the highest chance of an individual living in an area at risk to die (6.25 R in the table) from a flood is less then 10^{-6}. The latter is the value adopted for evaluation of the acceptability of a societal activity[31] with respect to personal risks in the domain of environmental policy making. The entry Landscape, Nature and Cultural heritage (LNC) attempts to capture the loss in these values[32] from the dike works required to comply with safety level. It is assumed that dikes are not smartly designed. The two bottom rows present the monetary evaluation: the net present value of a possible flood and the costs of the dike reinforcement. These indicators say that from a monetary point of view, the safety levels to consider should be much higher.

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30 The area of study encompassed the following dike ring areas (See Figure 2.2): 36, 38, 39, 40, 41, 43, 44, 45, 48, 49, 50, 51, 52, and 53.

31 For instance, risks associated with a chemical plant.

32 The methodology to quantitatively assess LNC values was earlier developed by the committee Becht in 1977.

Table 3.2 Costs and benefits of some options for a river flood risk policy.

Criterion	Unit	Safety level		
		1/1250 Rhine: 15,000 $m^3.s^{-1}$ Meuse: 3,650 $m^3.s^{-1}$	1/500 Rhine: 14,100 $m^3.s^{-1}$ Meuse: 3,350 $m^3.s^{-1}$	1/200 Rhine: 13.,000 $m^3.s^{-1}$ Meuse: 3,050 $m^3.s^{-1}$
Lengths of dikes to strengthen/ heighten	Km	350	290	255
Personal risk		R	2.5 R	6.25 R
Landscape	%	23	19	16
Nature	%	16	14	11
Cultural heritage	%	23	20	17
Damage at flood (Net Present Value)	Mfl	2,100	4,900	11,000
Costs of dike re-inforcement pro-gramme	Mfl	780	690	620

Source: Min V&W, 1993.

The study considered also smart and smarter and very smart design of dikes in order to save LNC values. For the 1/1250 safety level costs would about double in the very smart variant, while damage to LNC would then be restricted to 2 percent.

It is interesting to note that this study includes an analysis of the 1/200 return period for flood to occur, while the earlier committee Becht analysed 1/500 as the high variant. However, similarly to the Becht conclusions, the overall result is that the marginal benefits (LNC values) of pursuing a ‘high acceptable risk’ strategy seem to be low in comparison to the costs in terms of (potential) damage. The main reason for the low sensitivity of the LNC values for ‘safety levels’, or, in other words, for design heights, is that much of the current risk is due to a lack of dike integrity, in other words dikes may fail before the water levels reach design levels.

In contrast with the Becht committee, the Boertien committee did commission a - brief and theoretical only - analysis of the concept of differentiation of acceptable risk over dike ring areas. Not surprisingly the conclusion of such analysis (Walker, 1993) is that allowing flood risk policy to be different in terms of acceptable risk - return period for design water levels - would lead to strategies (outcomes) that could better take account of the interests of all stakeholders.

An interesting part of the methodology of the study (Walker *et al*., 1993) was that focus group meetings[33] were held in order to gain empirical insight in the nature of the interests that are at stake; the Becht study had also compiled such information, however only using written comments on their interim report.

The Boertien committee produced its conclusions in the spring of 1993: in the following winter the Meuse river flood large parts of the southern province of Limburg, in 1995 the river Rhine reached unprecedented levels, and large dike ring areas were to evacuated. These events prompted new legislation - the Delta Act Large Rivers (1995) - aimed to enable to speed up specific dike strengthening works by reduction of financial and administrative barriers. And in 1996 the Water Embankment Act was passed, already being discussed in the parliament for several years. As said before a major element in this last Act is that it endorses the principle of flood risks strategies to be differentiated by dike ring areas (see Section 2.5) For the time being acceptable risk - that is the acceptable over topping frequency - for the riverine dike rings was put at once in every 1250 year. For the other dike ring areas the - initial acceptable over topping frequency - are 10000 year, 4000 year and 2000 year. A important element of this Act is that it is required to re-evaluate flood risk each five years.

Next to the production of new legislation, the recent (near) flood events have spurred thinking on the high river discharges and their return periods. In the preceding studies, assumptions on the frequency of high discharges were based on an analysis of historical data, using the *ceteris paribus* assumption. It is true that in all studies the possibilities of climate change or sea level rise were considered, but these considerations played eventually a minor role. However, the recent hydrological events - and discussion on climate change - have enhanced the belief that it is likely that extremely high river discharges are more often to occur. From the climate change experienced in Western Europe, in combination with the effects of land subsidence and sea level rise, it appears the prospects for flood have worsened, possibly beyond the assumption - as used in current law - on the discharge frequency at Lobith implies.

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[33] Researchers meeting a group of people who have similar positions (stakeholders) in an issue - *e.g.* people active in landscape protection, or civil servants of water boards - and discuss the issue in order to find out what items (attribute of an issue) are found important and what values the different type of stakeholders give to each item. Five groups - persons who did not know each other - were formed: ‘action groups’, Environmental NGO’s, Civil servants, ‘local inhabitants (*dijkhuis* dwellers)’, and persons living in cities remote from the area. Two topics were discussed, the LNC criteria and criteria for the quality of the decision making process, *i.e.* openness, participation/democracy, en evaluation. In summary, the topics of discussion with respect to the LNC values prove to be: a holistic view of the river environment; preservation of natural heritage; change *versus* standstill; the need for variety; integrity of the ecosystem; recreation and safety. The panelists identified eight criteria for decision making procedures; openness; responsiveness; appeals; oversight; local autonomy; financing; timeliness and comprehensiveness. Two details of the meetings are that the meeting with the ‘action group people’ proved to be focused on procedural issues and distrust in authorities was a major item. A second observation was that the city dwellers did not have firm ideas about the issue.

Science bodies and experts ask for thinking about new strategies for water management to deal with this possibility. In the Government's 4th white paper on Water management - developed by *Rijkswaterstaat* - a principle on flood risk management - head on the no-risk society - is stated as:

"*But there is no such thing as absolute safety. Whatever we do, we may at some time face a water-level which our flood defences are simply not designed to withstand. We must learn to live with the awareness of that residual risk and be prepared to cope with such circumstances if they occur*" and "*For centuries, flood protection was virtually synonymous with dike-building and maintenance. However, the floods of recent years have taught us that sustainable protection means more than periodic dike strengthening. It can best be achieved by working hand in hand with natural processes wherever it is possible to do so. We need to step back and give the rivers, estuaries and coast more room to evolve*" (www.waterland.net/res.hdw.a/nw4-4en.html - March 1999).

In the policy making community it is advocated (*e.g.* RLG; 1998; Delft Hydraulics; www.wldelft.nl/rijn/) that, given the possibility of increased river peak discharge under climate change, it makes little sense to build higher and higher dikes, since costs and risks (stocks at high risk) will increase. Rather the approach should be to add new instruments for dealing with flood risks; that is to designate certain areas for temporal storage of peak flows or for bypass systems, while accepting the nuisance of occasional controlled (low depth) floods in such areas. Beginning with such an approach now, would require an adaptation of ongoing physical planning in the areas that might have a function in such extreme events water management. The policy guideline *Ruimte voor rivieren* (Room for Rivers) serves that purpose.

3.5 Conclusions

In the past fifty years, river flood risk policy making has changed in several respects. One of these elements is the concept of acceptable risk. In the context of flood risks policy making, acceptable risk is a probability for high water level to occur, that constitute the engineering guideline for designing the heights and strengths of dikes. Acceptable risk is agreed on politically. Such concept was introduced after the large tidal flood disaster in 1953; before, dike design guidelines were based on historically known highest water levels.

For the river delta in the Netherlands acceptable risk is derived from the statistics of river flow at Lobith were the river Rhine enters the Netherlands. Initially - 1956 - the number was set at once in 3000 year and it was assumed that this probability corresponded with a peak discharge of 18000 m^3/s (at Lobith, the place were the river Rhine enters the Netherlands).

As institutions operationally responsible for flood safety and dike maintenance, slowly, started to implement this guideline, under a business-as-usual approach, societal resistance to the embankment works rose. This is since to many the century old embankments that were to be adapted embodied major values of landscape, nature and cultural heritage. Simultaneously, under a trend of democratisation, resistance could be voiced and responded to in the political arena. While high discharge events failed to occur many years, a many years' discussion on flood risk policy evolved. These discussions – among various government bodies and stakeholders representing various interests - included studies addressing the issue how to reconcile flood safety and preservation of valuable landscape, nature and cultural heritage. Also the key assumption – acceptable risk – was reconsidered.

In 1977, after the first study, the national government adopted a new acceptable risk, once in 1250 year (corresponding with 16500 m^3/s, and leading to a reduction of required dike works), while in addition making possible - by additional funding - smartly designed and more expensive dikes that reduced damage done. Controversies, however, continued to exist. And in 1992 a more extensive study - and stakeholder discussion - was performed, considering for instance the implications of a once in 200-year probability of overtopping of embankments. This study considered also the possibility to differentiate in acceptable risks between areas, as a degree of freedom for finding optimal solutions. The government adopted the once in every 1250-year return period for river flood risks for all dike ring areas in the provinces of Gelderland and Overijssel alike. The argument for not adopting a higher risk was that increasing acceptable risk would result in only very limited gains in conservation of nature, landscape and cultural heritage, while (potential) flood damage would increase drastically. Geographical differentiation of risk was not thought to be politically feasible.

Meanwhile, dangerously high river discharges failed to occur, until 1995. The near flood disaster spurred developments. And in 1996, after a 15-year preparation the new (National) Water Embankment Act was adopted. An important element of this act is that it allows for differentiation of flood risk strategies. And the act says that each five year these strategies should evaluated. So the way is paved for the introduction of strategies for management of risks posed by peak discharges, that differ by dike ring area. And also the five year reviews allow for incorporating new insights, for instance derived for climate change studies.

In hindsight, we can view these developments as being rooted in four trends: integration, naturisation, democratisation and internationalisation (see Section 3.1). We understand ‘an integration trend’ as the phenomenon that in decision making in it has become more and more common to take account of the interests of different nature (as represented by different policy areas). In order to do so effectively, it is required to take account of different interest as early as possible in the decision making process. Identifying stakeholders and early stakeholder involvement in decision making is necessary to find socially accepted strategies to decide on. This element of the process of improvement of decision making may be called democratisation. So, in a way, democratisation is an aspect of integration.

Naturisation, the increase of the importance - in decision making - of the quality of the environment, particularly with respect to landscape and ecosystems, is clearly shown by the events with respect to dike reinforcements. This was particularly the case in the seventies, when the significance of this aspect was acknowledged at the national level. Naturisation is a concept that may have different connotations. In the Dutch context it expresses ideas and concepts about the future environment, that are in symbolic phrases such as ‘green rivers’, ‘dealing with water’, ‘giving room to rivers’, ‘living rivers’, and ‘growing with the sea’. These terms are underscored in various white papers presented by bodies such as *Rijkswaterstaat* and the *Raad voor het Landelijke Gebied* (advisory board for the countryside) (RLG, 1998).

The fourth trend would be internationalisation. Seeking flood safety by measures beyond the Dutch border started only recently.

Thinking has started about new approaches to flood risk management, prompted by an expected climate change, the recent hydrological events and a consequently decreasing trust in the concept of a reliable frequency distribution for peak discharges as a starting point for design of flood risk strategies. In other words, adopting a once in 1250 year discharge level as a guideline for dike design is actually deceptive, and flood risk strategies should address the possibilities of higher discharges. In a way, the approach to risk analysis adopted in 1956 - based on an historically justified assumption of high discharge frequency - , is left.

An important element in these new approaches is that some areas are to be designated for temporal storage of peak flood waves or by pass flows. Since these areas will be free of technological artefacts and are considered suitable for ‘creation of nature’, such approach fits into the naturisation concept (as opposed to heightening and strengthening of dikes). The consequence of this approach is that certain parts of the Netherlands adjacent to the rivers will run higher risks than other parts[34] adjacent to rivers. These parts would be selected by considering the stock-at-risk in these areas. In that way an overall cost-benefit balance supports these strategies.

One may put all this in the perspective of cultural change in terms of modernity and post-modernity. The belief in the possibility of establishing values for socially accepted residual risks is at the root of flood risk management in the fifties. Initially, this was the principle ground to base flood safety policies on. But over the years the rationale behind in flood risk strategies diversified, or flood risk strategies became more and more linked with other policy domains. Institutions changed to accommodate these changes. A late development is the dwindling belief in the possibilities to quantify flood risk. The uncertainty of what to expect from climate change contributes greatly to this process. Both the diversification of interest to take on board in design of flood risk strategies and loss of belief in risk calculations fit into post-modern cultural condition.

One may wonder about the possibilities for implementation of a ‘post-modern’ strategy. How would the inhabitants of the envisaged “high risk areas” feel about such strategy? Do they share the values embodied by such thinking? Are they willing to give up interests for ‘living rivers’?. How wide is the gap between the assumptions and theories of policy makers and the mental world of local people (Pressman and Wildavski, 1972)?. And, what are the possibilities to close such gap?. These are major questions when it comes to addressing an uncertain hydrological future. Chapter 5 addresses some of these questions.

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[34] This approach was abandoned in the mid of the 19th century.

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4. Games of Flood Control

Richard S.J. Tol[35]

4.1 Introduction

This chapter investigates games of flood control. It attempts to cast the secular trends of the Dutch history of flood management, as described by Langen and Tol (1998), in a formal framework. The history of flood management in the Netherlands is long and complex, and I do not pretend to give a definitive interpretation of all that happened. However, two remarkable phenomena can easily be explained with economic theory. First, free farmers, whose recent ancestors had escaped feudalism, voluntarily returned to feudal landlords, driven by increasing river floods. The economic interpretation is that a central authority has great advantages over a self-governing cooperation in managing the complex positive externalities of flood protection. This is the subject of Section 4.2. The second phenomenon is that feudalism, although beneficial in the short run, turned bad in the long run. Feudal landlords and their servants greatly abused their powers, creating corrupt, ineffective and even counterproductive flood management. The economic interpretation is that they were simply acting in their best interest. This is discussed in Section 4.3. Section 4.4 concludes.

4.2 The early days of flood control: Establishing a central authority

The purpose of this section is to investigate co-operation in flood control. More specifically, the analysis establishes that:

- positive externalities of individual flood control are substantial; so,
- co-operation is Pareto superior to non-co-operation; and,
- larger coalitions potentially improve welfare; nonetheless,
- co-operation is not individually rational; and,
- lack of information is a negative externality, growing with the size of the coalition; so,
- central control is required to ensure efficiency; and
- the optimal size of a coalition may be smaller than the maximum size.

1. Consider a farmer who lives on an island in the delta of a river. Every now and then, the river floods the island. This causes considerable damage. The farmer does not like this. He considers building dikes around his island. A dike of height h costs an

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annuitised $f(h)$ per metre.[36] $\partial f/\partial h>0$ and $\partial^2 f/\partial h^2>0$ since higher dikes need a broader base than lower dikes, and therefore use more material and labour to build. For example, $f(h)=\alpha h^\beta$, with $\beta\geq 1$. Assume, without loss of generality, that the island is perfectly square, with length l. Since the water comes from all sides at the same time, the protection offered is that of the lowest stretch of dike. The cheapest dike for a given level of protection is therefore one of equal height, and the costs of diking the island amount to $C=4lf(h)$.[37] The average annual benefits of building a dike are $B=g(h)$. $\partial g/\partial h>0$ since a higher dike offers more protection, and $\partial^2 g/\partial h^2<0$ since there is a maximum to the damage done by a flood and thus to the damage forgone.[38] For example, $g(h)=\kappa h^\lambda$, with $0<\lambda<1$. If benefits are discounted at the same rate as the discount rate with witch the costs of dike building are annuitised, the optimal dike height follows from equating the marginal costs and benefits. The marginal costs increase linearly with length of the dike. Using the example functions, $h^{opt,1}=(\kappa\lambda/4\alpha\beta l)^{1/\beta-\lambda}$. Clearly, the longer the dike, the lower it is. The higher is the damage, the higher is the dike.

2. Now consider two farmers, who are exactly the same as the above farmer, but live together on a rectangular island that is just double the size of the above island. If one the farmers decides to build a dike, and the other decides to build none, the calculus for the first farmer is the same as above. Since the farmers are the same, both decide to build a dike. If the two farmers absolutely mistrust one another, they would build a dike around their own lot exactly as if they were each on a separate island. The result is a double dike in the middle of the island. The two farmers would probably recognise this situation as silly. If the two farmers fully trust one another, each of them would have to build at three sides of their lot only. This would cost only $C=3lf(h)$, three-quarters of the original costs. The benefits would be the same. For optimality, the marginal costs of dike building should equal its marginal benefits. The optimal dike height is thus higher than in the case of one farmer. Using the example functions above, $h^{opt,2}=(\kappa\lambda/3\alpha\beta l)^{1/\beta-\lambda}$.

3. The case with four identical farmers on a square island is a trivial extension of the case with two farmers. If they all co-operate, the costs of dike building go down by a third, and the optimal dike height follows from $h^{opt,4}=(\kappa\lambda/2\alpha\beta l)^{1/\beta-\lambda}$.

4. The case with three identical farmers on a rectangular island is more complicated. If the three co-operate, $h^{opt,3}=(\kappa\lambda/(8/3)\alpha\beta l)^{1/\beta-\lambda}$, which is higher than in case of two farmers. However, the land of the middle farmer has only two stretches of dike, whereas the land of the two farmers at the ends has three stretches of dike. The mid-

[36] All dikes are assumed to be of equal strength. Differentiating between dike strengths would complicate the discussion without enlightening it. For similar reasons, dike building and dike maintenance are not distinguished.

[37] This assumes that there are no additional costs (or costs savings) per metre dike built for longer dikes.

[38] Note that these assumptions do not always match reality. A flood that leads to a dike burst does more damage than the same flood without dikes, because dike bursts lead to rapid flows of water. More damage would also be done if dike building leads to accretion of the river bed.

dle farmer plays a pivotal role. Full co-operation implies that the middle farmer somehow has to subsidise the other two farmers, with cash or labour or whatever. He would choose to subsidise the farmers at the ends of the island if $8/3lf(h^{opt,3})+g(h^{opt,3}) > 2lf(h^{opt,2})+g(h^{opt,2})$. If the middle farmer chooses not to subsidise, the two farmers at the end would build a dike as if it were an island of two inhabitants. The middle farmer would then spend 2/3 of their costs on dike building, but obtain the same level of safety. The farmers at the end would implicitly subsidise the middle farmer through the positive externality of flood safety. The middle farmer can also decide to be bribed. The farmers at the end gain $2(3lf(h^{opt,2}+d)+g(h^{opt,2}+d)-3lf(h^{opt,2})+g(^{hopt,2})$ for every extra *d* that the middle farmer adds to his dikes.

5. The case with more than four farmers gets even more complicated. Clearly, if all farmers co-operate, the number of farmers to share the costs of dike building grows faster than the costs of dike building. Thus, in the co-operative case, more flood safety can be gained at lower costs, to the benefit of each farmer. The fully co-operative case would yield the highest benefit for all farmers together, but it can only be maintained with transfers between farmers (as we saw in the case of three farmers). However, farmers with little or no water board would have an incentive to free ride on other farmers' dike building efforts. Some farmers would be in the position to try and take advantage of their pivotal position. This situation becomes more and more likely as more and more farmers are added to the potential co-operative, since the difference between a co-operative with *n* participants and one with *n-1* participants and *1* defactor decreases as *n* increases. At the same time, the gains of co-operation increase with *n*. The farmers would wish that there were a benevolent dictator who could ensure co-operation. Indeed, they would even be willing to sacrifice some of the gains of co-operation to pay for the necessary costs of such central co-ordination.

6. Now return to the case of two farmers, but two non-identical farmers. Farmers can differ in many ways. Their lots of land may be different. Their houses, or their crops may be different. Their perception of, or their attitude towards flood risk may be different. As a result, one farmer wants to build a higher dike than does the other farmer. Since the second farmer is sufficiently protected by the first farmer's dike building, he proceeds as if the first farmer is identical to the second and the two co-operate (cf. 2). The first farmer can do two things. Firstly, he can proceed to pretend he's alone (cf. 1). Secondly, he can subsidise the second farmer to heighten his dikes. The trade-off is between building a dike of length *l* or heighten a dike of length *3l*. Note that, if subsidised, the second farmer has an incentive to build a dike that is lower than he would have absent the prospect of a subsidy. Note also that the second farmer is better off in case the first decides to subsidise. In fact, if the two decide to co-operate, both can be better off than in case they decide not to. If may be, however, that the first farmer accepts reduced flood safety in return for compensation by the second farmer.

7. The case with *n* non-identical farmers has many possible solutions. If all farmers co-operate, total welfare will be greatest, but full co-operation requires an elaborate system of transfers between farmers. Central co-ordination becomes even more important than in case on *n* identical farmers.

8. We return again to the case of two identical farmers. This time, they are uncertain about the strength of the other's dikes. Since the water can come from all sides, what matters is the weakest dike (cf. 1). If the first farmer's dike is stronger than claimed, the second farmer does not bother. But, if the first farmer's dike is weaker than claimed, the second farmer experiences a deterioration of flood safety. The uncertainty about the strength of the first farmer's dikes thus lowers the expected benefits of building dikes. The uncertainty can be lifted by regular inspections of each other's dikes, but this would increase the costs of dike building. Reduced benefits or increased costs imply that the optimal dike height is lower than in the case without this type of uncertainty.

9. With *n* non-identical farmers, the uncertainty about the actual strength of the dikes becomes more profound. Firstly, it is harder to inspect the dikes of many other farmers, particularly those living further away. Secondly, as the situation is more complicated, there are more opportunities for individual farmers to try and turn the co-operative to their individual benefit. The case for central control is thus strengthened, not the least because it is often cheaper for one specialist to inspect *n* dikes than it is for *n* non-specialists to inspect *n-1* dikes.

10. Besides uncertainty about the strength of dikes, there is also stochasticity in the occurrence of floods. Let us return to the case of a single farmer. In 1, it was assumed that the farmer knows the benefits of dike building. It is more realistic to assume that the farmer perceives these benefits, or has a mental model of these. This model is somehow calibrated to the farmer's experiences, in which the most recent experiences are likely to weigh heaviest. This implies that, after a severe flood, high dikes are perceived as important. The actual dike height thus reflects some extreme flood in the past rather than the average flood regime.

11. A similar mechanism drives the case of many farmers. After a severe flood, the call for adequate flood protection is highest, so that not only average dike heights increase but also less co-operative farmers are more exposed to the pressures for central co-ordination of dike building.

12. Above, we identify positive externalities and imperfect information in relation to uncertainty and stochasticity as incentives to cooperate. However, we also identify that an elaborate system of transfers and information gathering is a necessary condition for cooperation. The design and implementation costs of a transfer system increases with the number of cooperating agents, and more than proportionally so. The same argument holds for information gathering. Thus, there are limits to the size of the coalition.

The above is a rather abstract discourse. The central findings, however, have parallels in the history of flood management in Rhine delta. A milder climate and technological progress led to increased population growth in The Netherlands around the year 1000. Previously uninhabited moors were colonised and cultivated, a process known as 'internal colonisation'. Cultivation implies drainage and subsequent subsidence of the land, increasing river flood risks. Colonist farmers first set-up local water boards to manage drainage and flood protection. The first local water boards appear to have been voluntary co-operations of rather independent-minded people, exemplifying the individuals *gains from co-operation. Local water boards merged to form regional water boards, from about 1250 onwards. This illustrates the positive scale effects found above. The early water boards soon sought legal security and stability with the count of Holland and the bishop of Utrecht. Note that, previously, the count and bishop had not had authority over the internal colonists. The new authorities codified dike building and maintenance, established rules and mechanisms are sharing costs, and appointed overseers for flood management. This can be explained by the propensity to free-riding and the costs of information gathering, which are much less with a central authority than without. Often times, a dramatic flood led farmers to yield their voluntary dike management and other freedoms to the landlord. This illustrates the interaction between variability and perceptions of risks.*

The forces for ever greater cooperation stalled in the 14th century. This was partly because general unrest in that period, partly because cooperation for flood management had reached the limits of political control, and partly because designing a transfer system and gathering information were very expensive. Cooperation again took off after the establishment of an effective central government in the Netherlands (1848) and again after river basin authorities became effective (1995). However, the use of the river and its catchment is now so intense that it is no longer possible to separate flood protection from drinking water production, navigation, nature conservation, recreation and land use planning. There are significant externalities between these various policy areas, and cooperation is needed. Water policies are currently reasonably well coordinated, but integration between water and land lacks.

The next section looks at flood management during the times of central, but not democratic, authority.

4.3 Centralised flood management

The purpose of this section is to analyse flood management by a central authority. The analysis establishes that:

- accretion is a private benefit but a social cost; therefore
- a central authority is needed to manage accretion;
- a selfish central authority can and will use its power to enrich itself at the expense of its subjects;
- servants of a selfish central authority can and will use its power to enrich themselves at the expense of its subjects.

1. Consider a farmer who lives on an island in a river. Suppose that there is accretion. If flood protection requires annual maintenance that is large relative to the capital investment in flood protection, the farmer could readily and cheaply extend existing flood protection to include the new land.
2. Consider a farmer who lives on a bank of a river. Suppose that there is accretion. Suppose that the farmer can add the new land to his current land without excessive costs. Suppose the farmer does so. The result of fixing newly accreted land is, first, increased erosion at the opposite bank and, second, increased flood risk because the river is narrower and windier. If the increased flood protection costs are largely borne

by other farmers, the first farmer protects the newly accreted land regardless of such considerations.

3. Consider a landlord who governs farmers on the banks of a river. Suppose that there is accretion. Suppose that individual farmers take advantage of this. Suppose that taxes are based on agricultural production. Suppose that flood protection costs are borne by farmers who own land adjacent to the river. In this case, the landlord benefits from extending the land, but does not loose from the increased flood protection costs as these are borne by his subjects. (In the long run, the landlord suffers from reduced investment in agricultural productivity, but these costs are negligible in a slowly changing, capital extensive agricultural production system with high political uncertainty.)
4. Consider a benevolent landlord. Suppose that everything is as in 3. The benevolent landlord would make the farmer with the accreting land compensate the farmers who face the increased flood risks and flood protection costs. Such a transfer scheme requires detailed morphological and hydrological knowledge as well as knowledge of flood protection costs and flood damages.
5. Consider again a selfish landlord. Suppose that there is accretion, and that the landlord owns the newly accreted land. The landlord has an incentive to fix the new land (*e.g.* to sell it), or to have it fixed (*e.g.* by selling the land and the right to fix it) if the costs of increased flood risks are borne by his subjects, and this does not affect the landlord’s tax base in the short run.
6. Consider a dike inspector. Suppose that farmers who own land adjacent to the river are responsible for dike maintenance and its costs. Suppose that the dike inspector, backed by the landlord, decides how dikes should be maintained. Suppose the dike inspector has the power to impose fines, lend money, and buy land. In that case, the dike inspector has the incentive to tighten flood control so as to weaken the economic position of the farmers. As a land owner, the dike inspector has a comparative advantage over other land owners and money lenders because the dike inspector controls part of the production costs, namely dike building and maintenance. As a money-lender, the dike inspector has a comparative advantage over other money-lenders, as the dike inspector has better information about the demand for credit, in fact partly controls the demand for credit.
7. Consider a benevolent landlord. He would check the powers of the dike inspector.
8. Consider a selfish landlord. Suppose that the tax base is agricultural production. Suppose that flood protection does not affect agricultural production. In that case, the landlord has no incentive to check the powers of the dike inspector. On the contrary, if the fines for real or alleged dike negligence flow to the landlord, or if the position of the dike inspector can be sold or granted as a favour, a tightening of flood control would be in the interest of the landlord.

We left the history of flood management in the Netherlands at the time cooperation was established and central authorities took control. Here, history takes a turn. Flood management being enforced from above, and often harshly so, land owners tried to turn the system to their individual advantage, even if this had clear social and long-term disad-

vantages. So did the landlord. In both cases, land reclamation in the river bed was the most profound example, enhancing erosion and making the river narrower and windier. Corruption at the water board was another problem. Dike inspectors imposed heavy fines and lent money at excessive interest rates. Many farmers were forced to give up their land, which was frequently bought by the dike inspector. As a result, floods got out of hand. Necessary conditions for a solution appeared to be public, centralised (in lieu of private, decentralised) flood management and a largely impartial corps of engineers and tax collectors.

4.4 Conclusions

Many of the developments in Dutch flood management history can be explained with basic economic reasoning, drawing on simple game theoretic insights.

Other developments go largely unexplained, at least, by this analysis. These include technological progress (the plough, the wind mill, cartography, the steam mill), climatic change (the Medieval Optimum, the Little Ice Age), and political development (Charles V, Napoleon, Thorbecke). Technological progress changed the pressure on land and water, and allowed for improved or novel management. Climate change altered land use and hydrology. Politics defines the space in which water management can move. These developments were largely independent of water management, but they did substantially influence water management.

The analysis shows that the early colonist farmers were right in seeking cooperation with each other. They were also right that they sought a central authority. Both developments improved their overall welfare, and for most their individual welfare. They were wrong, however, in placing central authority with landlords, who started off as benevolent regulators but turned into selfish extractors of surplus. The establishment of, first a more benevolent and, later, a democratic central authority helped improve flood management quite substantially.

4.5 Reference

Langen, A. and R.S.J. Tol (1998). A Concise History of Riverine Floods and Flood Management in the Dutch Rhine Delta. In: T.E. Downing, A.A. Olsthoorn and R.S.J. Tol (eds.) *Climate, Change and Risk*, Routledge, London, pp. 162-172.

5. Planning and decision-making related to the Maaswerken project

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5.1 Problem definition and methodology

The Dutch government and the province of Limburg are presently planning to undertake major infrastructur works in the valley of the Maas in the southern part of the Netherlands, the so-called *Maaswerken* project. These works, aiming at multiple objectives, have acquired the status of a 'major infrastructur project', because of their geographic, technical, financial and economic consequences. The *Maaswerken* project evolved, out of humble beginnings, into a major project in the course of the 1990s. Originally a project for nature development along the Grensmaas, it became a complex project encompassing a much larger stretch of the Maas, accommodating nature development, gravel extraction, improvement of navigation and security from high waters, at a spiralling total cost.

The complexity of the project presents the policymaker with special challenges in terms of planning, project structuring, division of responsibilities and participation. Recent history shows that the planning and decision-making processes related to comparable major infrastructural projects are often problematic and time-consuming, and that implementation is not always successful. Important reasons for their gestation are due to (Rhijnsburger, 1997):

- The number of acts, and planning and decision-making procedures that have to be applied;
- The different levels of public authorities involved, and
- The number and variety of stakeholders affected, such as local residents, farmers, and the business community.

Political culture is another important contextual variable here. The *Maaswerken* project is, or is presented as, the product of the typically Dutch type of consensual decision-making, both in its advantages, such as inclusiveness, and disadvantages, such as sluggish decision-making. In light of the inclusive philosophy of Dutch decision-making, the development of a support base within government and in society is extremely important. It has been noted that this has been especially difficult for large-scale projects, a number of which foundered in the 1990s (Rhijnsburger, 1997). Similar to projects elsewhere, the initiators of flood protection projects tend to feel the project needs to be 'sold' to the general public, as people are felt to have a false sense of security as a result of short memories of flood disasters (cp. Gardiner, 1998).

The main objective of the chapter is to provide a deeper insight in the policy and non-policy processes surrounding and affecting the establishment and development of the

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Maaswerken project. This insight is relevant in relation to the further implementation of the *Maaswerken*, but maybe even more in the context of similar large-scale projects which will be implemented in the Rhine basin in the first half of the 21st century. In summary, the chapter attempts to answer the question how planning and decision-making processes for the *Maaswerken* project do work out in practice and which bottle-necks are currently encountered. To structure the answering of this central question, a subdivision has been made in five research questions:

1. How has the *Maaswerken* project developed over time?
2. What does the trajectory of preparation, decision-making and execution of the *Maaswerken* look like?
3. Who are the stakeholders, and to what extent are they involved in planning and decision-making?
4. What is the current progress of the *Maaswerken* project?
5. What issues are the source of (potential) conflicts which hamper the realisation of the *Maaswerken*?

The chapter is based on a literature review and a series of interviews with key decision makers and local stakeholders. We stopped with gathering information in October 2000. The literature study included an evaluation study of the Delta Act for the Main Rivers, official governmental and NGO documents, regional newspapers (database on internet and clipping service of the ministry of VROM), and a series of reports about the part-project Grensmaas produced by the University of Maastricht.

The structure of the chapter is largely based on the research questions mentioned above. Section 5.2 presents, as a starting point, some geographical and hydrological facts about the Maas river basin. Section 5.3 continues with a historical overview of the development of the *Maaswerken* project. Section 5.4 further elaborates on the content of the *Maaswerken* project and the procedures to be followed, whilst distinguishing between the project as a whole, and the constituent projects for the Grensmaas and the Zandmaas. This chapter also mentions relevant stakeholders, their positions in the planning and decision-making procedures and the current state-of-affairs in the *Maaswerken* project. Section 5.5 gives some background information about the key issues that are playing a role in the policy and non-policy processes, and that are giving or may give cause to conflicts. Section 5.6 contains conclusions.

5.2 Some geographical and hydrological facts

The source of the Maas is situated in the north of France, near the city of Nancy, at a height of 409 m above sea level. From its starting point, the river flows through France, Belgium, and the Netherlands into the North Sea. The Maas is a rain-fed river of more than 850 km with 30 tributaries. The total catchment area is about 33.000 km², and encompasses 9,000 km² in France, 13,500 km² in Belgium, 4,000 km² in Germany, 600 km² in Luxembourg and 6,000 km² in the Netherlands (van Leussen *et al*., 2000). See also Figure 2.1.

The Maas crosses the border of the Netherlands at Eijsden at a height of 45m, and runs through the city of Maastricht. The subsequent Dutch sections of the Maas include (Rhijnsburger, 1997):

- the Grensmaas, between the villages of *Borgharen* at the border and *Stevensweert;*
- the Zandmaas, between the villages of *Stevensweert* and *Mook/Boxmeer;*
- the Oevermaas from the villages of *Mook/Boxmeer* to the sea.

The Grensmaas, which marks the border between Belgium and the Netherlands, is not diked, and is used for the extraction of gravel. The Grensmaas is not suitable for navigation. Ships use the bypass channel, the *Julianakanaal*, which was constructed in the 1930s. The Zandmaas is also not diked, and is used for the extraction of sand. Finally, the Oevermaas is slightly different in that it is heavily diked. Since the execution of the emergency Delta Plan for the Main Rivers (*Deltaplan grote rivieren*) during 1995, embankments (*kaden*) have been constructed along several, previously undiked stretches (see also Section 5.3). When compared with dikes, embankments are not such large constructions.

The river Maas has many functions. Some of them, for example its use as commercial fishing water, are in decline, others such as its role as a source of hydroelectric power have only recently emerged (Nijhof, 1998). Among the most common functions of the Maas are (Rhijnsburger, 1997):

- navigation;
- agriculture in the river floodplains;
- extraction of sand and gravel;
- recreation;
- production of drinking water for the cities of The Hague and Rotterdam;
- production of industrial water;
- discharge of waste.

The average annual input of the Maas to the water budget of the Netherlands is 8,400 million m³ (being 10% of the input of the Rhine), in a dry year this may drop to 3,500 million m3 (TNO, 1986). Being a typical rain-fed river, the water discharge varies throughout the year depending on the amount of rain and snow in the catchment area, with relatively high peak flows in winter and generally low flows in summer (Weyden, 1997). The years between 1911 and 1995 saw the yearly average discharge at *Borgharen*, the official measuring point in the Netherlands, at 230 m³/second (Nijhof, 1998). The highest discharge of the 20th century was measured in 1993 and amounted to 3,120 m³/second (van Leussen *et al*., 2000). This is an occurrence that statistically happens only once in 125 years. It resulted in a large scale flooding. In 1995, when there was again a flooding, the maximum discharge was 2870 m³/second. At present, 3,800 m³/second is considered to be the normative discharge level (V&W, 2000). This level was previously established at 3,650 m³/second. In practice, half of the normative discharge level is already considered a critical discharge value, because then large areas of the floodplains are starting to inundate (van Leussen *et al*., 2000).

The water storage capacity of the catchment area of the Maas is limited, especially in the central reaches in Belgium (van Leussen *et al*., 2000). Moreover, infrastructural works and urbanisation have accelerated the water discharge to the river which may lead to higher peak water levels. In the period from 1850 up to the present day, there have been four major floods in the province of Limburg which caused considerable damage (Weyden, 1997). Table 5.1 mentions the dates when these occurred, including the peak water levels measured in the city of Maastricht. Statistics show indeed that the number of peak level discharges have increased during the last century.

Table 5.1 Peak water levels measured at the Sint Servaasbrug in the city of Maastricht (the average winter level is 43.00 m.)

Year	Highest water level
1880	46.95 m
1926	46.92 m
1993	45.90 m
1995	45.71 m

Source: Weyden, 1997.

The risk of damage and inconvenience due to floods has also increased, because the valley of the Maas, including the winter bed of the river, has been exploited more intensively for industrial, infrastructural and building activities over the last 150 years than in previous ages (Weyden, 1997).

5.3 The development of the Maaswerken project

In our report about the institutional framework for the management of the Rhine and the Maas (van der Grijp and Olsthoorn, 2000), it was concluded that extreme water levels and flooding events have been the reason for drastic policy changes in flood risk management. This statement, however, needs to be put into a more appropriate perspective as the following historical overview aims to demonstrate. More specifically, it will be clarified how the ad hoc perceived need for action after a flood leads to the taking of measures which are most of the time based on already designed plans and projects, but with a reframing of the policy context and a speeding up of the implementation. Table 5.2 summarises the events that determined the development of the *Maaswerken* project.

Traditionally, the riverbeds of the Maas have been used to extract sand and gravel. In the years between 1984 and 1994, gravel extraction companies excavated about 90 million tons of gravel in the valley of the Maas, meeting a contractual obligation with the central government (Rhijnsburger, 1997). The gravel is applied as a raw material in the Dutch concrete industry. The large scale gravel extractions resulted in the creation of deep pits which were filled with water and were locally considered to provide damage to values of nature and landscape. The deep pits are now being used for water recreation purposes, especially wind surfing and jet-skiing.

In 1990, however, the provincial strategy towards gravel extraction changed. It was due to increasing protests by the local population and environmental organisations, that the Minister of Transport, Public Works and Water Management (V&W) and the province of Limburg agreed to allow the extraction of another 35 million tons in the period from 1990 up to 2015 and then stop with the gravel extraction completely. In spite of the agreement, the public resistance against gravel extraction did not diminish. To give in to the objections, the province of Limburg commissioned a consultancy agency (*Bureau Stroming*) to explore socially and environmentally acceptable alternatives for gravel extraction in the Maas valley. In 1991, the consultancy came up with a plan for the

Table 5.2 Historical overview of the development of the Maaswerken project (1990-2000) .

Year	Event
1990	The province of Limburg starts to explore alternatives for gravel extraction in the Maas valley, which in fact is the renewed start of the planning process for the Grensmaas.
1991	Start of the project *Maasroute.*
May 1991	The consultancy *Bureau Stroming* presents its plans for the Grensmaas: Green for Gravel (*Groen voor Grind*).
1992	Declaration of intention to restore “natural values” in the Maas valley. Parties to the Declaration are the ministries of V&W, LNV, and the province of Limburg.
December 1993	Floods in the catchment area of the river Maas.
1994	Declaration of intention between Dutch and Belgian authorities to co-operate in the Grensmaas project.
February 1994	The Minister of Water Management and the provincial authorities of Limburg establish the advisory commission *Boertien II* to explore strategies to diminish the risk of flooding in the future.
December 1994	The advisory commission *Boertien II* advises to speed up the execution of Green for Gravel (*Groen voor Grind*) and to construct embankments along the Maas.
December 1994	The government takes over the advice of the commission *Boertien II* and decides that the necessary works should be finished by 2005.
January 1995	Again floods in the catchment area of the river Maas.
February 1995	The government establishes the Delta Plan for the Main Rivers (*Delta Plan Grote Rivieren*). The Delta Plan also marks the start of the planning process of the Zandmaas project.
1995	The EU Council of Environment Ministers signs the Declaration of Arles, declaring that action plans on flood protection should be prepared for the Rhine and the Maas.
1995	The Minister of Water Management announces a fundamental change in flood risk management after 2000, notably to create more space for rivers.
1996	The Ministers of Water Management and Environment introduce policy guidelines regarding a restricted use of floodplains (*Ruimte voor de Rivier*).
April 1997	Coupling of all three projects related to the Maas by the creation of the project group *Maaswerken*.
Late 1997	The Minister of Water Management decides to prolong the realisation of the *Maaswerken* up to 2015, because of budget constraints.
April 1998	The international Flood Working Group Maas presents its action plan for flood protection.
May 2000	The Minister of Water Management makes additional funds available to the *Maaswerken* project.

Grensmaas, combining gravel extraction and nature restoration, which was called Green for Gravel (*Groen voor Grind*). To the developers of the plan, it was only a minor detail that the proposed measures would lead to a diminished flood risk. Interestingly, the ‘Green for Gravel’ plan is partly based on ideas about nature development in the Grensmaas area, which were developed in the early 1980s but then foundered because of political tensions in the provincial government (van der Veen & van Zanten, 1990).

Around Christmas 1993, there were long lasting floods in the Maas valley, leading to the evacuation of 8,000 people and a total financial damage of € 115 million. Immediately after the floods occurred, the Minister of V&W and the authorities of the province of Limburg instated the advisory Commission Flooding Disaster Maas (*Commissie Watersnood Maas* or *Commission Boertien II*), which had to explore strategies to diminish future flood risks in the valley of the Maas. That same year, the commission presented an analysis of several measures to improve the risk situation, and recommended the following measures to be executed in the period from 1995-2015:

- to deepen the Maas in Northern and Central Limburg;
- to broaden the Grensmaas, while simultaneously developing values of nature and landscape (according to the plan "Green for Gravel");
- to provide additional protection by the construction of embankments (*kaden*) along the undiked sections of the Maas;
- to prohibit further building activities in the winter bed of the river, and
- a variety of small-scale measures.

The piece of advice concerning the Grensmaas was based on the 'Green for Gravel' plan from 1991. The commission stressed that the execution of this plan not only serves the two previously stated objectives of gravel extraction and nature restoration, but also the objective of increased protection against floods. Shortly after, the government adopted the recommendations of the Commission, and decided that the necessary works should be finished by 2005 instead of 2015. First priority should be given to the broadening and deepening of the river bed, and then embankments should be constructed over a length of 60 km.

In the beginning of 1995, there were again floods in the Maas valley. This time the financial damage amounted to about € 90 million (Van Leusssen *et al*., 2000). In reaction to the new floods, and the near flooding of the Rhine, the government decided to establish an emergency plan, the Delta Plan for the Main Rivers (*Deltaplan grote rivieren*), which included speeding up the implementation of the recommendations delivered by the Commission Flooding Disaster Maas (*Commissie Watersnood Maas*). To achieve its objectives as fast as possible, the government decided to swap priorities. The construction of embankments should be done first, and along a larger stretch, notably 145 km of embankments instead of 60 km. The works should be finished before the end of 1995. After the realisation of the embankments, floods would only occur at a maximum of once in 50 years. Subsequently, the broadening and deepening of the river would be started with the completion foreseen for 2005. The risk of flooding would then be reduced to once in 250 years. The consequence of the new order of priorities has been for nature development to take a backseat.

The Delta Plan for the Main Rivers also marks the start of the planning process for the Zandmaas project. At the same time, the government decided to couple the Zandmaas project and the Maasroute project, because of converging objectives. The latter project, originating from 1991, has as its main purpose the improvement of the navigability of the river Maas, and more precisely that of the *Julianakanaal* which flows parallel to the Grensmaas.

The Delta Act for the Main Rivers (*Deltawet grote rivieren*), which covered dike reinforcement works along all main rivers, was evaluated shortly after its expiry date. One of the case studies in this evaluation describes the construction of embankments in the province of Limburg (Driessen and de Gier, 1997). As the evaluation report describes, the two regional water boards in Limburg carried the primary responsibility for the preparation and execution of the embankment plans. One of the water boards, the *Waterschap Peel en Maasvallei*, managed the construction works in the Northern and Central part of Limburg, whereas the other, the *Waterschap Roer en Overmaas*, managed the works in the Southern part of the province.

The two water boards had no practical experience at all with the construction of embankments. Therefore, they hired people from well-known technical consultancies, such as *Grontmij* en *Heidemij*. The State Water Management Authority (*Rijkswaterstaat*) restricted itself to the provision of technical advice. Concerning the role of the regional authorities, it was the task of the province to issue guidelines to assess the embankment construction plans of the water boards, and to co-ordinate all other projects related to the Maas. For this latter purpose, the province established the Provincial Consultative Group Maas (*Provinciale Overleggroep Maas (POM)*). In practice, however, the setting of guidelines and the co-ordination of projects did not live up to the expected potential (Driessen & De Gier, 1997).

During the planning process, arrangements were made for informal public participation. Information gatherings were organised for the local population, and organisations of stakeholders were asked for their opinions. When the draft embankment construction plans were ready, the population could participate in the formal decision-making process, by delivering complaints or going into appeal. Most complaints and appeals concerned the level of protection offered (too low), specific technical specifications, and the loss of view (Driessen & De Gier, 1997). Nobody objected though to the basic idea of embankment construction. For the execution of the embankment constructions, the public authorities needed to buy out land of private owners. This resulted in the conclusion of 600 contracts of sale on a voluntary basis, and in 15 cases property owners were forced by law to sell their land (Driessen and de Gier, 1997).

The costs of the construction of the embankments were initially estimated to amount to € 31 million. In the course of the project, the estimation of costs has been re-adjusted substantially three times. Finally, the costs amounted to € 80 million. These re-adjustments were largely due to the increased length of embankments (145 km instead of 60 km), and the strict interpretation of the 1: 50 years protection standard by the water boards (Driessen & De Gier, 1997). As was planned in the early months of 1995, most of the envisaged embankments were indeed realised towards the end of the year.

By the end of 1995, and following the floods and near-floods of 1993/1995, the central government decided to come up with a priority change in flood risk management to be able to cope with increased flood risks in the 21st century. To achieve this aim, the emphasis after 2000 will be on the increase of the storage and discharge capacity of rivers, instead of further dike reinforcement. To facilitate the implementation of the new policy, it was deemed necessary to strengthen the linkage between flood protection and spatial planning. To provide guidance about activities to be allowed in the winter bed of rivers, the Minister of V&W and the Minister of Environment (*VROM*) published the policy document Room for the River (*Ruimte voor de Rivier*). These guidelines are in accordance with a recommendation by the Commission Flooding Disaster Maas (*Commissie Watersnood Maas*), issued in 1994. In practice, the guidelines imply that new building activities are no longer allowed in the winter bed.

In 1997 it was decided to couple all three projects related to the Maas through the creation of the project group *Maaswerken*. Table 5.3 summarises the objectives of the integrated project.

Table 5.3 Formal objectives of the Maawerken project.

For the Grensmaas area:
• to ensure a flood risk of at most 1: 250 years
• to create about 1000 ha of natural values
• to extract at least 35 million tons of gravel
For the Zandmaas/Maasroute area:
• to ensure a flood risk of at most 1:250 years
• to improve the navigability of the river Maas and the Julianakanaal
• to restore natural values but only to a limited extent

A reason for coupling all three projects was that the province did not want to carry the immense financial burden that the three projects entailed. With the conclusion of the agreement, the central government took over the financial responsibility for the three projects. Shortly afterwards, in late 1997, the Minister of V&W decided to prolong the realisation of the *Maaswerken* up to 2015, because of budget constraints. As things are now, it is still planned that all works related to the Maas will be completed in 2015.

At the international level some progress was made with the implementation of the Declaration of Arles, which was signed by the EU Council of Environment Ministers in 1995. According to the declaration, action plans on flood protection should be prepared for the Rhine and the Maas by the countries concerned. On April 8, 1998, the riparian countries in the Maas river basin agreed on the Action Plan High Water Maas. The basic philosophy is the retention of water for a longer period in the catchment area of rivers and to give more space to the river and its tributaries. The action plan is based on five principles (Van Leussen *et al*., 2000):

1. The focus should be on integrated, multidisciplinary and solidary actions in the perspective of sustainable development.
2. People should be made aware of the residual risk.
3. Land use activities should be seen from a water perspective.
4. Water should be stored for a longer time in the watershed and released more slowly.
5. Space should be created for the river and its tributaries.

It is expected that the Flood Working Group Meuse will publish its quantitative objectives in the course of the year 2000.

5.4 The Maaswerken project: organisation, stakeholders and procedures

5.4.1 Central project organisation Maaswerken

The *Maaswerken* project group is a public partnership of two national governmental agencies and a regional one: the ministry of V&W, the ministry of Agriculture, Nature Management and Fisheries (*LNV*), and the province of Limburg (Van Leussen *et al*., 2000). It is notable that the ministry of Housing, Spatial Planning and Environment (*VROM)*, which is responsible for land use planning as well as environment, is not a partner in the project group. The ministry of VROM is more loosely and informally involved to monitor the spatial planning procedures and the environmental aspects of contaminated dredging material.[41] A covenant establishing the public partnership was signed on April 10, 1997. In practice, the regional department Limburg of the State Water Management Authority (*Rijkswaterstaat*) took the lead in the project management. To increase the support base for its activities, the project group claims to maintain intensive contacts with other stakeholders, including municipalities along the river Maas, regional water boards, nature protection groups, tourist organisations, agricultural organisations, the regional Chambers of Commerce, and local interest groups (Van Leussen *et al*., 2000).

With the establishment of the project group *Maaswerken*, the Provincial Consultative Body Maas (*Provinciale Overleggroep Maas (POM)*) and a few other consultative bodies were discontinued (*Bestuursovereenkomst voor het Maasproject*, 1997). As a substitute for these bodies, the Administrative Consultative Body Maas (*Bestuurlijk Overleg Maas (BOM*)) was established, which performs the day-to-day management of the project. The parties involved in this body are the ministry of V&W, or - more precisely the State Water Management Authority (*Rijkswaterstaat*), the ministry of LNV, the ministry of VROM and the province of Limburg. The same parties are also represented in an advisory committee meant to inform and support the project director (*Directeurenoverleg Maas (DIROM)*).

5.4.2 Planning process and procedures

The development of the project plan for the *Maaswerken* can be characterised as a so-called open planning process, with all stakeholders being invited to participate. In the 1990s, Dutch government has increasingly switched to an open planning approach, also known as interactive policy making. This approach implies that government bodies solicit opinions on their proposals from individuals, NGOs and other government bodies, at an early stage when modifications are still possible (Mostert, 1999). It is usually combined with consensus seeking processes between all participants, so called diagonal policy. In the *Maaswerken* project, this participatory process is taking place at formal as well as informal levels.

For both part-projects, there are in principle three alternatives to increase the discharge capacity of the Maas: broadening, deepening or a combination of both. These alternatives have all in common that they have significant spatial planning implications. In a

[41] Int. 4, spatial planner, 08/01/00.

densely populated country such as the Netherlands, where land is scarce, spatial planning processes are highly detailed. Coupled with the culture of consultation, this has given rise to a dense trajectory of procedures for each project. For the realisation of the *Maaswerken*, for example, it will be necessary to pass through 5,000 permitting procedures (http://www.demaaswerken.nl, 25/01/00). In this context, it is remarkable that the regulatory framework to enable a project of this size is not well-developed. Adequate legal and administrative instruments to facilitate planning, decision-making and execution are largely non-existent. The responsible authorities have to muddle on with the large amount of procedures that are prescribed in various laws. It has been argued that infrastructural projects such as the *Maaswerken* need new legal instruments, because unprecedented situations are met, or situations where the present legislation is an obstacle to achieve real solutions (Van Leussen *et al*., 2000).

Before we take a closer look at the two components of the *Maaswerken* project in the next two sections, we will first give an overview of the stakeholders formally and informally involved in the decision-making on the Grensmaas and Zandmaas/Maasroute part-projects.

Table 5.4 Formal and informal involvement of stakeholders in the decision-making on both part-projects of the Maaswerken.

Types of stakeholders	*Grensmaas*	*Zandmaas/Maasroute*
Ministries		
- ministry of nature conservation (LNV)	++	+
- ministry of water management ((V&W-RWS)	++	++
- ministry of public housing, spatial planning and environment (VROM)	++	++
- ministry of economic affairs (EZ)	+	+
- ministry of welfare and public health	+	+
Provincial authorities		
- province of Limburg	++	++
- province of Noord-Brabant	-	++
- province of Gelderland	-	++
- purification board Limburg	+	++
- water board Roer en Maas (area of Grensmaas)	+	-
- water board Peel en Maasvallei (area of Zandmaas)	-	+
Others		
- municipalities	+	+
- gravel extraction companies	++	-
- environmental organisations	+	+
- nature protection organisations	++	+
- local interest groups	+	+
- individual local residents	+	+
- farmers' organisations	+	+

++ formally involved
+ informally involved
- not involved

5.4.3 Project Grensmaas

Plans for greening the Grensmaas area, a rather attractive part of the Netherlands (see Figure 5.2), have preoccupied the provincial government since the early 1980s. Inspired by the French river Allier (see Figure 5.3), which is felt to resemble the look of the Maas in earlier times, the Grensmaas project seeks to restore the river to a wild stream with an interesting variety of habitats. Instead of fixing the riverbank, the original channel is broadened; the river will remain free-flowing. Gravel extraction will broaden the river channel (2-3 x) and lower the floodplain over a 45km stretch of unembanked river (*Borgharen* to *Roosteren*). This will dampen the flood risk as well. After shallow gravel extraction for broadening and deepening, the Maas will be left to its own devices which, it is hoped, will create a varied wilderness. The nature creation aspect is hoped to boost tourism.

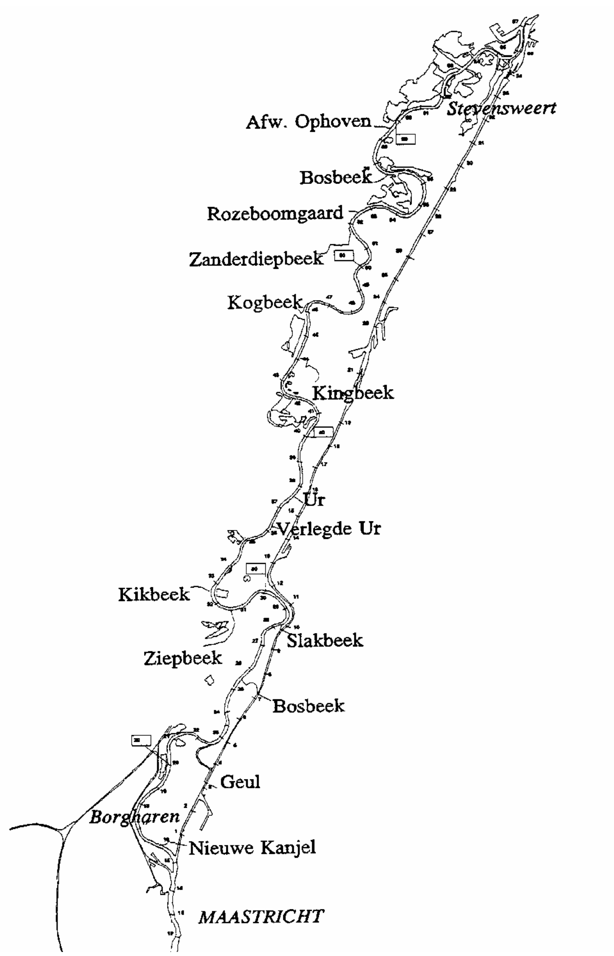

Figure 5.2 The Grensmaas and the adjacent Juliana canal.

It was realised early on that the Grensmaas project was going to be a very costly project. To make the project more cost-effective it was felt that the gravel sector and the conservation movement needed to be co-opted, both of whom have extensive landholdings along the river Maas. So interestingly, the executive consortium involves both public, private, and NGO actors. Because of the commercial outlook, the national public forestry agency, *Staatsbosbeheer*, was prevented from participating. Instead, the NGO input is provided by *Natuurmonumenten*, a large nature conservation group and landowner representing all nature and environmental stakeholders. By dint of its participation, *Natuurmonumenten* in fact participates in a market venture, an unusual step in Dutch terms.

Figure 5.3 Picture of the French river Allier, a guiding example for nature creation along the river Grensmaas. Source: Middelkoop, 1998.

In light of the decision to take a market approach, it was necessary to involve a private gravel extractor group to provide the market savvy to make the most of the gravel sale. There has been a constant pressure from gravel extractors to create deeper pits rather than shallow dredging with a view to a higher yield. It is easy to imagine the problems of reconciling the 'gravel' and 'green' views.

Table 5.5 Landmarks in the planning and decision-making processes about the Grensmaas.

Date	Publication of
February 1994	Starting Memorandum Grensmaas project
July 1994	Guidelines for the Environmental Impact Assessment
February	Interim memorandum describing several alternatives
May 1998	Environmental Impact Assessment
	Draft revision provincial land-use plan (*streekplan*)
Planned for 1998	Final version revision land-use plan (*streekplan*)
Planned for 1999	Permitting procedures based on several acts
Planned for 1999	Draft reconstruction plan for the area (*Landinrichtingsplan*)
Planned for 1999	Operational plan for the Grensmaas project
Planned for 1999	Final decision Grensmaas project
Planned for 2015	Plan for integrated management of the Grensmaas area
Planned for 2015	Re-establishment of the Belgian/Dutch border

Source: Rhijnsburger, 1997, Projectorganisatie De Maaswerken, 1999 and several newspaper clippings.

Table 5.5 gives an overview of the landmarks in the planning and decision-making processes for the part-project Grensmaas. As the table shows, the Grensmaas project is still in its planning stage with some major decisions that still have to be taken. In the meanwhile, a variety of pilot projects have been, or are being, executed in the project area to get experience with the restoration of nature, and the deepening and broadening of the river beds (Projectorganisatie De Maaswerken, 1999). The first pilot projects started in 1990; they concerned the restoration of natural values (pilot projects *Kleine Weerd, Frayere du Petit Gravier, and Eijsder Beemden*). A second type of pilot project started in 1999; it concerns the broadening of the river bed and the creation of a nature protection area (pilot project *Meers*). A third type of pilot project also started in 1999. It concerns the widening of a river bend (pilot project *Roosteren*). At least one of these pilot projects shows delay due to complication in the permitting procedures (see also Section 5.5.5).

5.4.4 Project Zandmaas/Maasroute

Flood protection and improvement of the shipping lane are the main objectives of the Zandmaas/Maasroute project, but nature protection is also receiving attention (Van Leussen *et al*., 2000). As this stretch is not so striking as a landscape, however, the need for specific amenities was not as obvious. The enhancements are piecemeal, and the nature protection organization *Natuurmonumenten* is much more skeptical and aloof. It endorsed a critical reaction by the joint environmental organizations to the project director of the Zandmaas. The ambiguity is also reflected in the fact that it took four years to complete the environmental impact assessment (EIA), and that this report was subsequently dismissed by the independent assessor (*MER-commissie*). In this light it is unlikely that the creation of an executive consortium for the Zandmaas will run smoothly, it is in this area that enhancements for nature development are likely to be scrapped when cost overruns prove too big.

To facilitate the decision-making process, four alternative plans have been presented, with costs varying between € 380 and € 1,045 million (ANP, 3/2/1999). The so-called Combination Alternative, one of the cheaper options, combines deepening of the main stream with nature development at specific locations along the river. In addition, some flood and side channels are proposed as well as retention area near the city of *Roermond* (*Lateraalkanaal West*). However, it has been recently recognised that extra measures will be necessary to cope with extreme water levels (Van Leussen *et al*., 2000).

Table 5.6 shows that, similar to the Grensmaas project, there is also delay in the planning process for the Zandmaas/Maasroute project. The final decision about the trajectory is now expected in 2001. For the time being, pilot projects are being executed in the project area to get experience with the deepening and broadening of the river beds (Projectorganisatie De Maaswerken, 1999). The first pilot project started in 1996; it concerns the deepening of the river bed (pilot project *Gennep-Grave*). The second pilot project started in 1998; it concerns broadening of the river bed (pilot project *Swalmen-Beesel*). Unfortunately, this project proves to be more expensive than was calculated beforehand (De Limburger, 7/7/00). A third pilot project started in 1999 (pilot project *Steijl-Grubbenvorst*).

At the local level, there is a growing resistance against the planned heightening of embankments which should contribute to an increased safety level in the short term. This has resulted in a bottom-up initiative. In early 2000, seven municipalities launched an alternative plan for the area around the city of *Venlo* which gives a higher priority to nature restoration and development (*Plan Maascorridor*) (De Limburger, 6/5/00). The project group *Maaswerken* is presently assessing the alternative plan for its contribution to the stated safety objectives and for its financial consequences. As far as this assessment concerns, the first conclusions about the effects on discharge levels are positive, but the project group has announced that the financial aspects need a further analysis (De Limburger, 8/9/00).

Table 5.6 Landmarks in the planning and decision-making processes about the Zandmaas/Maasroute.

Date	Publication of
October 1995	Starting Memorandum Zandmaas/Maasroute project
May 1996	Guidelines for the Environmental Impact Assessment
Augustus 1996	First annex to the Starting Memorandum about storage depots for contaminated soil material
March 1997	Second annex to the Starting Memorandum about storage depots for contaminated soil material
June 1997	Additional guidelines for the Environmental Impact Assessment
August 1997	Memorandum describing several alternatives (*Notitie Maasvarianten*)
January 1999	Environmental Impact Assessment
February 1999	Presentation of four alternative trajectories and start of formal public participation (inspraak)
Planned for medio 1999	Draft-decision trajectory Zandmaas/Maasroute
Planned for 2000	Final decision trajectory Zandmaas/Maasroute

Source: Projectorganisatie De Maaswerken, 1999, and several newspaper clippings.

5.5 Issues at stake

As has been explained in the previous sections, the Maaswerken project shows less progress than expected. It was envisaged that the planning process would be finalised at the end of 1999 and that the execution of the necessary works could start in 2000. However, the planning process is still underway, and the execution of the works has not been started, except for some pilot projects. Several issues can be identified that are giving, or may give, cause to conflicts and delay, thereby threatening the realisation of an increased protection level in the Maas valley. In our elaboration of these issues we have not tried to be exhaustive. The mere purpose of this section is to give an impression of all the complications that may surround the realisation of such an ambitious infrastructural project. To structure the description of (potential) conflicts, we made a categorisation into five groups. They will be dealt with in subsequent sections:

- Objectives of the project;
- Establishment of a public/private partnership;
- Co-operation between authorities;
- International co-operation;
- Level of local public support.

5.5.1 Objectives of the project

The *Maaswerken* project serves the objectives of safety against high waters, nature development, gravel extraction and improvement of navigation, all at the same time. The interpretation of these objectives, however, may vary between the different stakeholders involved. In this section these interpretation conflicts are elaborated for the objectives of increased protection against floods, and nature restoration and development.

Technical measures have to be taken to achieve the envisaged protection level. Therefore calculations have been made that are based on peak level discharges and peak water levels, now and in the future. By the end of 1999, the project group Maaswerken admitted that the calculations concerning the necessary height of the embankments had been inaccurate, that the calculated protection levels realised by the combined works had been too optimistic, and that additional measures would be necessary to create a sufficient level of protection (De Limburger, 25/02/00).

Most controversially, the construction of embankments could lead to a so-called "bath-tub effect". In case of extreme high water levels and failing embankments, there could be sudden floods putting local lives at risk because there is no spillway. Opinions differ whether, in the event of a breach, there will be enough time for evacuation. Should the embankments be overtopped, there would be very little time for warning and evacuation, and lives could be lost (van der Ven and van Dooren, 1997). The spokesman for the Maaswerken was forced to admit that: 'Should an embankment fail, people could even be drowned who used to watch the water rise gradually. Therefore in future evacuation will take place.' (De Gelderlander, 13/08/99 (translation JW)). Not only has the evacuation experience been traumatic, which makes the prospect of a repeat frightening - the arrangement would make the newly created situation more dangerous than it was before, turning a high-incidence, low-consequence risk into a low-incidence, high-consequence event.

Another contested issue is the time schedule for achieving the envisaged protection level of once in 250 years. According to the project planning, the 1/250 years norm should be realised for the whole Maas valley by 2015, but for the densely populated areas (80% of all Maas sections) already by 2006 (van Leussen *et al*., 2000). Several stakeholders involved have serious doubts whether this time schedule is realistic. In this respect, the sequencing of the project is important: it decides who is protected by the protective measures.

Furthermore, it is expected that at the end of the 21st century the peak water levels will increase by about 20% as a consequence of climate change (van Leussen *et al*., 2000). This aspect was ignored in the emergency flood safety reinforcements after the 1993 and 1995 floods. Presently, discussions are going on how to manage the expected heavy discharges, and it is generally felt that the relation between water management and spatial planning needs extra strengthening, for example by reserving areas for temporarily storage of access water, or so-called controlled flooding.

Originally the sequence of part-projects ran from South to North. However downstream stakeholders noted that some upstream works would increase river discharge downstream, temporarily leading to higher exposure levels to high water. It has been stated for example that the stretch between the villages of *Boxmeer* and *Ravenstein*, will be temporarily less safe. The responsible water board in the area therefore wants the project works to be realized in the North-South direction rather than South to North.

Concerning the objective of nature restoration and development in the Maas valley, the major contribution will be provided by the Grensmaas project. When the plan was developed in 1991, the designers have been looking around for examples of nature types that could be realised in the Grensmaas region. Finally, they decided that the river *Allier* in France provided the most attractive reference to copy. In their enthusiasm, they even compared the future situation with the European equivalent of the tropical rainforest (Heykers, 1998). However, it may be doubted whether the type of nature envisaged by the plan designers comes close to the ideal of the local residents.

After completion of the preparatory measures, nature will be allowed to develop itself. It is expected that the realisation of the new situation will take 25 years. However, there is a real fear among the population that nature restoration will get a lower priority in case financial problems occur during the project realisation. The nature conservationists are also apprehensive of the possibility that the project is abandoned or compromised after only part of the project is implemented. They deem it most likely that in the end, vital measures for nature development, which are the least cost-effective, will not be realized to cut costs.

5.5.2 Establishment of a public/private partnership

The responsible authorities hope and expect that the major part of the costs for the Grensmaas project can be paid from the revenues of sand and gravel extraction, but both the question of funding and the agreement between the partners to the executive consortium for the Grensmaas project have been dragging on for some time. Moreover, despite several ultimatums and the help of a mediator, the partners have not been able to present a concrete executive plan yet.

Even now, the Terms of Reference (*Programma van Eisen*), the 'what' of the project is still in flux, making it difficult for the practical detail, the 'how' of the project, to be hammered out by the executive consortium. Both 'games' are mutually interdependent, which was likened by one interviewee as 'playing on two chessboards'. This is obviously slowing down the process, and has caused apprehension in both co-opted parties. [42] *Panheel*, the gravel group, sees its continued survival put at risk. The lead time for new projects is up to 10 years, in part due to extensive permission procedures. Even a fast-track procedure would take 5 years. The gravel group feels it needs something solid when the last concession runs out in 2003. As the process drags on, *Panheel* has made application for non-*Maaswerken* concessions. This has not endeared the gravellers to the authorities (Limburgs Dagblad, 7/1/00).

From early on, the consortium of gravel extraction companies (*Panheel* Group) has explored ways to strengthen its position. Already in the first stages of the project planning, the gravel companies bought land from provincial and local authorities in the gravel-rich parts of the Maas valley. By establishing property rights in the area, they tried to make their participation in the project inevitable. Subsequently, the Panheel Group filed an ap-

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[42] Int. 2, contractor, 28/02/00, and int. 3, environmentalist, 10/03/00.

plication for dispensation of the trust rules with the antitrust regulator NMa in 1991, while arguing that the complexity of the project warranted this specific consortium rather than open tendering. If the request will be granted, this could have as a consequence that the Dutch authorities are deprived of the chance to conclude a contract on better conditions with a foreign gravel extraction company. However, NMa is still in the process of taking a decision. Antitrust legislation against consortia can only be avoided when the public partner can invoke an overriding 'higher interest'. The *Panheel* Group is now waiting for the government to pronounce this overriding interest, which it has not yet been willing to do.

The issue of the trust rules is related to public procurement legislation of the EU that prescribes open tendering for procurement contracts that exceed certain financial thresholds. These rules, which were first issued in 1971, are aimed at transparent procedures with the final goal to facilitate fair competition between companies in all member states. The procurement rules are also applicable to the tendering procedures for gravel extraction when the project involved is worth over € 2.25 million (EU directive 93/37/EEC dealing with the tendering of public works). This is certainly the case for the envisaged gravel extraction in the Grensmaas area. If NMa decides to turn down the request of the gravel consortium, an escape from public procurement rules would be to split the works into a great number of smaller works, but this would make co-ordination cumbersome (http://www.nma-org.nl).[43]

5.5.3 Co-operation between authorities

The *Maaswerken* project touches on historic sensitivities at several levels - both between core and periphery, between provinces and between riparian states. The latter issue will be dealt with in Section 5.4. The province of Limburg was traditionally the mining area of the Netherlands. When the mines closed, mass unemployment and poverty ensued. For decades, Limburg politicians demanded, and got, compensating measures. Limburg lobbyists grew accustomed to having their requests granted. In the 1990s, however, relations turned sour. The Central Bureau of Statistics, brought to Limburg as a job machine, was dismantled, a planned new motorway (A73) was almost not planned at the preferred riverbank and in 1997, the Minister decided to defer funds for the Maaswerken. Some have linked this to the political change at national level: the ‘purple politics’ of the 1990s.

According to a Limburg administrator himself, the perception of Limburgers in the Hague is that of the type that would sell their own mother to have their way: They always come (to the Hague) to see what they can get.[44] Likewise, the province managed to get a compensatory deal for heavy rainfall while the *Maaswerken* have not been completed when it proved impossible for the government to make a deal with the insurance industry. On the other hand, Limburg feels belittled by the Hague, which it feels is downplaying the security issue. As no-one has yet been drowned in a Maas flood, a huge expenditure for a 'dry-feet' issue does not seem warranted.

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[43] Int. 2, contractor, 28/02/00.

[44] Int. 5, provincial administrator, 08/02/00.

In the last year and a half, the planning and decision-making process for the *Maaswerken* took place in an increasingly deteriorating atmosphere between the public authorities involved. In addition, critics started to argue that neither a proper cost-benefit analysis nor a risk analysis has been made, and that the decision to start this large-scale infrastructural project is the result of a hype created by the media after the floods of 1993 and 1995. Consequently, public support for the project began to crumble off. This development was even more reinforced by the performance of the project group *Maaswerken*, that is perceived by some as deceptive and money-consuming.

The relationships between the various public stakeholders though have recently slightly improved. On 30 March 2000, representatives from the ministries of V&W and LNV, and the province of Limburg have met to discuss how to proceed with the *Maaswerken* (De Limburger, 31/03/00). During this discussion the ministry of V&W has committed itself to a larger share in the financial burden of the project. As it is now, the precise contribution is unclear, but it is considered to amount to several hundreds of millions of Euro. Furthermore, it was decided to put the project group *Maaswerken* under supervision of a group of high public officials and political authorities, and to create an equal partnership between the ministries of V&W, LNV, and the province of Limburg. Previously, the ministry of V&W had a dominant role, or at least was perceived to have all the steering power.

All is not well between the southern provinces either. For example, the project group *Maaswerken* received comments from the provinces of Noord-Brabant and Gelderland that the proposed measures in the province of Limburg could lead to increased risks of flooding in areas further down the river, for example in the city of ‘s Hertogenbosch. They feel Limburg should solve its high-water problems within its realm (De Gelderlander 13/08/98; De Limburger 08/06/99).

5.5.4 International co-operation

Co-operation between France, Belgium and the Netherlands is required in the context of the international Action Plan High Water Maas from 1998. The Dutch *Maaswerken* project could be executed more cost-effectively when there is co-operation and co-ordination especially with the Belgian authorities. As an upstream country, Belgium has the power of obstruction on the Maas by arresting the stream or flooding downstream areas. History shows that this is not far-fetched, but the federalization of Belgium enabled Flanders to break the impasse resulting in a 1995 treaty (*Verdrag inzake de afvoer van het water van de Maas van 17 januari 1995*).

In the early 1990s, the Belgian counterparts have expressed a positive attitude towards the Grensmaas plans, and have made their own version based on a similar philosophy. However, Belgium badly wants Dutch consent for the reinstatement of the 'Iron Rhine' commodity railway which, on the basis of the Belgian separation agreement of 1838, should be allowed to pass Dutch territory. The Dutch however have been uneasy about this plan as, among other reasons, the railway would crosscut the Meinweg, a site of special scenic interest. While it is unlikely to give rise to a diplomatic conflict in itself, only through the linkage with the passage, procedural obstruction is a definite possibility (Osinga, 1997). The real possibility that Belgium will delay co-operation for the

Maaswerken project if concessions on the railway project are not forthcoming, has long been hovering over the project.[45]

In territorial terms, the *Thalweg* issue is important, as some 200 hectares are expected to change hands as natural processes triggered by interventions in the Grensmaas make the *Thalweg*, which marks the border, change. The Grensmaas project is projected to result in a net transfer of 200 ha of Dutch territory. Currently, the *Thalweg* is fixed at 1978 measurements, but the key line is going to change and its shifts will be much more dynamic. This impinges on rights to gravel extraction and proceeds thereof, and compensation for changes. Islets that emerge as a result of nature development may alternate between two jurisdictions on a daily basis.

5.5.5 Level of local public support

The realisation of the *Maaswerken* will take at least 15 years. Local residents fear for all kinds of nuisance and inconvenience (Heykers, 1998, several newspaper clippings and interviews):

- subsidence (caving-in) of their houses;
- production of considerable noise and dust;
- creation of a lunar landscape during the execution of the works;
- decreased safety for children as lorries may regularly traverse quiet areas.

Unhelpfully, communication on the part of *Maaswerken* project group is presently not as abundant as it has been in previous stages. According to a spokeswoman for the nature protection organisation *Stichting Ark*, for example, local inhabitants have not been told that the permitting procedures for the pilot project at Meers are subject to delay. This has caused that the works have been brought to a halt, leaving huge piles of sand and gravel obscuring resident's view on the Maas (Ark, pers. comm; 27/04/00).

The enduring social dismay at noise pollution and environmental damage caused by gravel and sand extraction caused the province of Limburg to conclude a covenant with The Hague to phase out operations in the late 1980s. Only 35 million tonnes more would be allowed.

However, the Grensmaas 'Green for Gravel' plan in effect could double that amount, in the name of nature creation. This caused resentment in Limburg, as it was recalled that the province of Limburg has been plagued by political scandals over construction and gravel extraction in the early 1990s. It was duly noted that the original plan for the Grensmaas was advanced by a politician who was later incriminated for taking kickbacks and having overly cosy relations with, among others, Panheel and van den Biggelaar, two key gravel players (Dohmen, 1996).

This set the scene for the pilot project at the village of *Lomm*, where a trial channel was dug and archeological excavations were carried out. The Malta Convention requires archeological excavation prior to infrastructural works. The local action group *Lomm Actief* feels digging trial trenches (*proefsleuven*) near the remnants of *Lomm* water mill should be stopped. It suspects the archaeological research carried for the *Maaswerken* is

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45 Int. 1, project director, 31/01/00.

not aimed at conservation, but is more in the economic interest of the sand extraction company. 'Suddenly the archeological finds are not important anymore. The quarry and channel (*geul*) happen to be unimportant for the security of people' (De Limburger 02/09/99). At first *Arcen en Velden* municipality, of which *Lomm* forms part, opposed the channel. A year later, however, it consented after it was promised extension of its industrial estate and a permit for new residential development (NRC 21/04/00). To the people of *Lomm*, this seemed another example of political wheeling and dealing, especially as no decision has yet been taken over the preferred alternative for the Zandmaas/Maasroute project (De Limburger 15, 17, 19, 22, 28 April 2000).

5.6 Conclusions

The Maaswerken project is a highly complex undertaking with far-reaching financial, economic, technical, spatial and political implications. This major project evolved out of three smaller projects, which were coupled in 1997, intending to integrate a variety of policy objectives at the same time, including nature development, gravel extraction, flood protection and improvement of navigation. The complexity of the project presents the policymaker with special challenges in terms of planning, project structuring, division of responsibilities, and participation. Project planning and execution will cover a period of at least 25 years, with the planning process for the constituent projects already starting in the early 1990s, and the actual realisation of the full project foreseen for the period from 2000 up to 2015.

The 1993 and 1995 flood events in the Maas valley and concern about the hydrological implications of climate change have prompted policy changes. The floods provided a window of opportunity for reviving existing plans for environmentally sound gravel extraction, but strongly reframed in a flood security context. The implementation of this safety element was fast-tracked and speeded up before all else. However, although the intended measures have considerable potential in mitigating flood risk problems in the longer run, they are perhaps not the hoped-for breakthrough in coping with increased flood risk. New calculations taking greater account of climate change-induced rainfall variability necessitated the serious exploration of additional measures such as retention and controlled flooding.

As this section has shown, the *Maaswerken* project is proceeding less successfully than expected. The planning process was envisaged to be finalised by the end of 1999 and execution to be started in 2000, but the time schedule is already lagging behind. The Maaswerken project has been and still is the source of a broad range of conflicts, concerning for example the distribution of costs between governmental stakeholders, the position of the gravel extraction companies, the handling and storage of heavily contaminated dredging material, the accuracy of technical calculations, the restriction in land-use options, and frustrations of the local population about their peripheral position in decision-making. Moreover, it is ever more stated that there must be a project approach that is more simple, more cheap and more effective.

It is also clear that legal and administrative instruments to facilitate planning, decision-making and execution of the project are inadequate or even missing. The responsible authorities have to work with an enormous number of procedures, prescribed in a variety of laws that touch on related issues. An envisaged special procedure for large infrastructural works (*Rijksprojectenprocedure*) is hoped to remedy this in part, but is slow in coming.

The above-mentioned conflicts in combination with the complicated procedures have caused serious delay in the planning process, and have also had their repercussions on the negotiations between the public and private partners in the executive consortium. Moreover, the central government has deemed it necessary to intervene and has put the project group Maaswerken under supervision of a group of high public officials and political authorities. In addition, the partnership between the two ministries involved and the province of Limburg is now placed on a more equal footing.

In a previous paper (van der Grijp and Olsthoorn, 2000) we identified four trends in Dutch flood risk management: nature restorisation, integration with other levels of policy-making, increased democratisation and internationalisation. These trends are all four observable in the Maaswerken project, but not always very convincingly. With regard to nature restoration, the future will show to what extent the ambitious objectives for nature development will be realised. There are already fears that the ever-increasing costs of the project will be at the disadvantage of the ecologisation process.

With regard to integration of different policy objectives, a major feature of the *Maaswerken* project as such, practice shows that extensive processes of consultation, co-ordination and co-operation between several levels of policy makers have been started. Although it is clear that serious efforts are made to make the best of it, these processes are not always easy-going. The experiences of the project group *Maaswerken* are an example thereof.

With regard to increased democratisation, the *Maaswerken* project counts as an extensive exercise in participation, informally and formally. However, the project group adopted a ‘selling’ rather than a ‘co-production’ approach. As a consequence, several stakeholders feel irritated and ‘bulldozed’ by the information overload brought in by the initiators. In addition, there are centralising tendencies in the decision-making structures, with the ministries of Water Management (V&W) and Nature Management (LNV), and the province of Limburg in the dominant positions. Lastly, with regard to internationalisation, the co-operation in the framework of the Flood Working Group Meuse seems to start off very slowly, and has not resulted in any concrete actions yet.

Compared with previous large infrastructural projects, the current state of affairs in the *Maaswerken* project does not point at a fundamental shift in approach and outcome. The planning and decision-making processes are still problematic and time-consuming activities with little guarantee of successful implementation. Public participation seems to be largely limited to the provision of information and possibilities for appeal.

With regard to present flood risk, it is important to consider what would happen if a high-water level comparable to that of 1993 or 1995 occurred today. It is generally felt that the consequences would be far less serious now that embankments have been constructed along major stretches (especially protecting residential areas), flood warning systems have been improved and more municipalities have contingency plans in place. Locally, however, there might be an increased risk of flooding to selected residents due to work in progress resulting in the creation of temporarily less safe stretches, slightly increased risks to unprotected isolated homesteads and expected problems due to the 'bathtub effect' turning high-incidence, low-consequence risks into low-incidence, high-consequence risks for those living in bunded areas.

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6. Nature or Neighbour in Hell's Angle: Stakeholder Responses to Future Flood Management Plans for the Rhine River Basin

P.E. van der Werff[46]

6.1 Introduction

> *One professor says 'it will be dryer', the other one says 'it will be wetter'.*
>
> *We all have mobile telephones so we know it when the water comes.*
>
> *The social cohesion of this community will be lost forever.*
>
> *When you're not bought out you'll be the real victim.*
>
> *We like to have a nature reserve area around here.*

This chapter concerns responses of stakeholders who live in an envisaged wetland in the Rhine river basin. Plans for the creation of a major wetland in the eastern part of the Netherlands are launched that would serve the joint purpose of being a retention basin, a bypass during high water discharges, a nature conservation area, and an attractive place for recreational activities. As the wetland would be entirely inundated at intervals of 5-10 years, the residents in the area would have to be relocated. Notably the population of the hamlet of Helhoek, literally *Hell's Angle*, would be affected. The study aims at responses of local stakeholders to the far-reaching management ideas.

Proposals for the creation of a large wetland are not limited to this area alone. In the Netherlands it is widely recognised that changes in the physical environment are putting more pressure on the river system and require a far-reaching shift in water management. Moreover, in the Netherlands there is such a strong, historically engrained aversion to floods that water is regarded as the hereditary enemy number one of the people. This notion has led to a *zero-risk society* that is ready to make great sacrifices in order to prevent floods.

However, the present water management plans do not only derive from a perceived increase in flood risk. They also reflect changes in wider society where basically two approaches to reality have come to exist that are usually labelled as *modern* and *postmodern*. The *modern* approach is found in the presently implemented flood plain policies and will be briefly reviewed and illustrated below. The *postmodern* approach will be further elaborated as it guides, among other things, the radical ideas for future river basin management under study here.

In abstract terms, attention is given to *modernity* as a wide set of established patterns of thought and behaviour, and *postmodernity* as a number of social trends, understood as ongoing changes in patterns of thought and behaviour. These trends may or may not result into more fixed, established, *institutionalised* patterns of thought and behaviour.

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Moreover, it is relevant to look at the interactions between *modern* established patterns and *postmodern* trends. Such interactions take place between actors or organisations, as well as within the heads of individual actors or within organisations. Finally, the research is facing gradual and radical shifts that occur from *modern* patterns to *postmodern* trends, and from these trends to institutionalised patterns of thought and action.

The present paper regards these dynamics as studied in Dutch river basin management where they create new sources of new opportunities for actors to explore and exploit, and conflict and complication. At the detailed empirical level, it reports on a field study undertaken among stakeholders living in the eastern part of the province of Gelderland. Here, in the area between Lobith at the River Rhine and Doesburg at the River IJssel, a major wetland is envisaged that would be a retention basin during high water discharges in the River Rhine.

More precisely, the trend of *naturisation*, as it is locally called, is taken to as the main *postmodern* trend that penetrates water management. This trend aims at preserving or restoring natural habitats, replenish groundwater stocks and benefit recreation. Simultaneously, it contributes to reducing flood risk. As such, it provides a means of adapting to sea level rise, higher river water discharges, soil subsidence, and increased density of flood plain habitation. However, the trend of *naturisation* is not only a logical response to physical changes, but also a part of the gradual shift from *modernity* to *postmodernity*.

The trend of *naturisation* has generated a number of ideas about reconstruction of the Rhine and Meuse river basins (Ministerie van Verkeer en Waterstaat, 2000). One idea concerns the creation of the wetland bypass between the rivers Rhine and IJssel for the joint purpose of diversion and retention of excess water, and conservation of wetland nature. This so-called *Green River* would also bring the periodic submersion or isolation of farms, households and business firms. Notably, the population of the hamlet of Helhoek would be entirely relocated. Like other localities in the eastern part of the Netherlands, this hamlet is known for its strong social cohesion that would be lost if the relocation would take place.

6.2 Pre-modernity, modernity, post modernity

Naturisation is both a result and a proponent of a tendency towards considering long-term sustainability of both society and the environment. It emphasises the need for comprehensive and flexible styles of analysis, policy making and implementation in various ways. Applied in river basin management, it advocates integrative thinking about hitherto separately treated functions of the physical environment such as safety, agriculture, residence, tourism and transport.

Second, the trend of *naturisation* attempts to integrate *hard* technology and economy with *soft* ecology and environmentalism. Third, it acknowledges and stimulates flexible integration between societal segments or domains such as politics, governmental organisations, civil society and the private sector. Fourth, it is part of the tendency towards more balance and interaction between top-down, authoritarian thinking and bottom-up, democratic thinking.

The trend of naturisation can be seen as being part of an overall shift in society from *modernity* to *postmodernity* that affects the thinking and acting in technology, economy, management, and recreation. In paraphrasing and citing a leading author about the subject, David Harvey (1989), it is found that *modern* planners tended to look for mastery of a physical area as a totality by deliberately designing a closed form and constructing 'once-and-for-all' solutions. *Postmodern* planners, on the other hand, tend to consider long-term processes, and view these as rather uncontrollable, full of uncertainty, or even chaotic - as processes in which anarchy and change are 'playing' in open situations.

What emerges is the norm of seeking out pluralistic and organic strategies in approaching reality as a collage of differentiated spaces and mixtures, rather than pursuing grandiose plans based on functional, separate zoning of activities. This shift coincides with a denunciation of the reductionist 'enlightenment' worldview and its perceived powers of universally applicable science and technology. It rather entails a reorientation towards more openness, flexibility and intuition as the basis for decision making and implementation (Harvey 1989, Toulmin 1992).

The shift also implies the gradual diversion of power from the nation-state towards localisation and internationalisation. *Modern* river basin planners tended to look for mastery of a physical area as a totality by deliberately designing a closed form and constructing supposedly 'once-and-for-all' monolithic projects, with the nation-state as the power centre. Nature is supposed to be conquered and human interventions not to resemble perceived natural features such as uncertainty and chaos.

Postmodern river basin planners, on the other hand, tend to consider long term processes and wider contexts. They appreciate natural features and acknowledge the physical environment as rather uncontrollable, with anarchy and change 'playing' in open situations. There is a shift from supposedly once-and-for-all, technocratically devised, state-controlled projects to flexible, integrative, nature conserving projects, with power shifting to citizens, local authorities, and international bodies. More appreciation emerges of organic, dynamic, unpredictable life in both society and nature (see Table 6.1).

The rise of environmental awareness itself may even spring from *postmodernity* (Brand 1999). Also in environmental management there is a shift from supposedly once-and-for-all, technocratically devised, state-controlled projects to flexible, integrative, nature conserving projects, with power shifting to citizens, local authorities, and international bodies. Nature is no longer supposed to be conquered and human interventions are perceived to resemble natural features such as uncertainty, fragmentation, change and chaos.

Table 6.1 Features of postmodernity leading to naturisation.

Diversity
Flexibility
Play
Chance
Deconstruction
Laissez-faire, deregulation

According to some, then, the rise of environmentalism does not so much relate to a perceived deterioration of the physical environment, including climate change, but to rather to contemporary changes in thinking and acting that stem from social sources. More precisely, the upcoming trend of environmentalism is seen as an 'integral part of the transformation of the cultural experience of space and time in the conditions of postmodernity' (Brand 1999).

Postmodernity, as a noticeable shift in sensibility, practices and discourse formations, can be regarded as *modernity* taking a critical look at itself. Broad circles in society aim an increased scrutiny at the *modern* belief system. A first core element of this belief system is the priority of instrumental rationality encapsulated in the scientific, *cartesian* worldview. A second element in the set of modern beliefs is the conviction that progress is based on individual freedom and self-realisation. A third element is the idea of history as the linear development that occurred in Europe and would set the example for other societies in the world (Beck 1992, Brand 1999, Huyssens 1984, Lash, Szerszynski and Wynne 1996, Riddle 1998, Toulmin 1992).

In contrast, *pre-modern* social organisation is based on personalised relationships. Contacts are less rational or neutral than in *modern* settings and more easily include emotional, spiritual and physical aspects, disregarding of whether they are felt as pleasant or unpleasant. *Pre-modern* contacts also called *many-stranded* because of its inclusion of many aspects of social life. Finally, a particular contact is not regarded as a one-time affair, preferably terminated completely. Rather, it is kept open-ended, with ongoing obligations and expectations in order to secure future safeguards (Wolf 1966). *Pre-modern* societies often show interactions of people with nature in similar fashions. The physical environment is not rationally treated as a set of objects available for one-time, maximum exploitation as in the *modern* worldview. It tends to be seen in its ongoing presence and future functions while limited technological capacities restrict overexploitation as well.

Postmodernity, in turn, aims at overcoming the dangers of *modernity* while moving forward instead of trying to return to *pre-modern* conditions. The *postmodern* trend of *naturisation*, then, has generated a number of ideas about reconstruction of the Rhine and Meuse river basins, including for the creation of so-called Green Rivers as retention basins and bypasses (Ministerie van Verkeer en Waterstaat, 2000). The plan for a Green River between the rivers Rhine and IJssel is a one of them. It is also a clear example of the shift from *modernity* towards *post-modernity*, whereas the plan will come to affects the *pre-modernity* of the village of Helhoek.

6.3 Helhoek in three domains

The stakeholders of Helhoek comply to and deviate from the three domains of *pre-modernity*, *modernity* and *post-modernity*. And through their activities they bring about interactions between these three domains. Section *6.10. Social cohesion at stake* depicts Helhoek as a remarkably strong *pre-modern*, close-knit community based on personalised, *many-stranded* relationships. They consciously preserve mutual care, positive social control and a large number of voluntary associations. A collective relocation is felt to result in the loss of these *pre-modern* acquisitions and therefore seen as the most important disadvantage of the Green River plan. As described in Section *6.11. Social cohesion against interventions*, the Helhoekers are prepared to prevent this loss collectively, and with deliberation and skill.

Remarkably, for naturisation planners it is not difficult to see the value of social cohesion in villages such as Helhoek. Apart from their wide differences, both pre-modernity and post-modernity pursue cohesion, if not in society then through acknowledging the forces of ecological systems and processes. The trend towards *naturisation* keeps applying high standards for safety and defending technological and economic interests, but adds the safeguarding or restoring of organic unity in the physical environment. This addition would contribute to the viability of the nature-society systems in the long run.

At the same time, Helhoekers maintain instrumental, single-stranded relationships that deal with only one aspect of life. They mostly engage in such contacts with actors outside their own village community. Sections 6.12-6.14 illustrate how they both benefit from and contribute to *modern* state arrangements, technological innovations and economic growth, and suffer from technological drawbacks, social alienation and a reductionist worldview.

They are taking part in *postmodern* developments as well. They contribute to and are informed about trends such as more openness and flexibility in decision making. They understand the wisdom of combining the priority of safety with ecological management of the river basin. They increasingly participate in planning processes. They consider the necessity of international co-operation for managing the river Rhine and think about long-term sustainability of projects. Their request is that plans are based on detailed knowledge of their interests and that power centres stick to decisions once made.

Helhoekers, finally, are part of the emerging *postmodern* domain as well. They contribute to and are informed about features such as more openness, flexibility and intuition in decision making and management regarding the environment and society. Remarkably, *post-modern* and *pre-modern* features show certain similarities here, such as intensified interaction and local social cohesion.

In addition to their participation *within* the three domains, the citizens of Helhoek manage interactions *between* these domains. A major example is the encounter between the national, *postmodern* emphasis on ecological systems and the local, *pre-modern* conservation of the social system. The futuristic river flood risk management that emerges clearly interacts with the much-acclaimed social cohesion of agrarian villages such as Helhoek.

In their relationships with the *modern* state government bodies, they have quite some confidence in the financial compensation for relocation, as was witnessed during expropriation procedures for other infra-structural works nearby. But based on the same experience, Helhoekers will negotiate about financial compensations with skill and determination. Their tactics will be reinforced by collective efforts that stem from their remarkably strong social cohesion that belongs to the *pre-modern* domain.

To summarise, the collective and individual defence of stakes in the Green River area is quite coloured by the dynamics of the domains of *pre-modernity*, *modernity* and *post-modernity* that occur at different levels of scale (see also Table 6.2). In turn the defence of stakes and the relevance of the three domains is intertwined with the alertness, power positions, access to resources, negotiation skills, and levels of organisation of the local stakeholders and actors in the outside world. The dynamics of such complex encounters affect the implementation of Rhine river basin policies and its local consequences.

Table 6.2 Analytical dimensions in water management.

	Pre-modernity	Modernity	Postmodernity
International level	Insignificant	Insulated policies of nation-states	Treaties European Union
National level	Insignificant	Authoritarian approach	Interactive approach
Local level	Responsibilities of local bodies	Dependent on national government	Co-responsibilities of civil society

6.4 The flood plains option

As indicated above, adequate safety measures have the highest priority in the Netherlands. Broadly, the safety of western, downstream areas is seen to improve if, in the event of high discharge, floodwater can be temporarily stored in eastern, upstream areas of the country and flushed northward to the sea. Therefore, in this upstream area, measures for local safety, storage and flushing have to be combined.

As mentioned, some plans and projects fit into the *modern* type of thinking and acting, whereas other ones show the signs of *postmodernity*. A prominent *modern* project is called *Ruimte voor Rivieren* (*Room for Rivers*). It is devised in a top-down way by technocratic centres at the national level. It joins in with the reinforcement of dikes during the 1990s and aims at deepening the flood plains immediately bordering the summer course of rivers and removing constructions that obstruct the flushing of excess water (see Figure 6.1).

The project *Ruimte voor Rivieren*, then, regards the deepening of flood plains with about two meters. The governmental water management department *Rijkswaterstaat* favours this plan and is now implementing it. The project is supposed to increase substantially the water discharge capacity and does not affect the land use pattern outside the sparsely inhabited flood plains. It keeps societal upheaval and political controversy to a minimum and thus precludes conflicts with civilians and politicians that civil servants tend to avoid.

A counter-argument is that this plan rather ignores flood risk problems related to climate change. Moreover, siltation of the flood plains will continue which makes the solution unsustainable. And still hundreds of houses and other constructions would e inundated or have to disappear (Rijkswaterstaat 1999, Agrarisch Dagblad 1999, De Gelderlander 1999, De Volkskrant 1999, Trouw 1999). A recent study found that costs for removing about 500 enterprises in the flood plains would take more then 700 million guilders (Metro 1999).

6.5 The green option

The rise of *post-modernity* in Dutch river basin management shows in a number trends of which many have integration as a common denominator:

- Simultaneous consideration of short-term and long-term perspectives.

- Simultaneous consideration of diverse parts and functions of the physical environment.
- International collaboration.
- Collaboration between various governmental bodies.
- Collaboration between decision-makers and the providers of knowledge.
- Participation of the private sector and the civil society in government domains.

This set of trends became evident in the international conference on integrated water resources management living with Water (IAWQ, EWPCA and NVA 1994) and the subsequent publications by Van Rooij and others in *European Water Pollution Control* in 1995, 1996 and 1997.

Similar trends are visible in the rather far-reaching plan for future river basin management called the 'green option'. The plan was launched to provoke a discussion about profoundly different styles of water management in the country. It was designed by the research institute *WL / Delft Hydraulics* and launched under the name *Rijn op Termijn* (*Rhine In The Future*) in 1998. The institute has an independent status since a few years but still maintains strong ties with the government. It developed the plan in consultation with governmental organisation *Rijkswaterstaat*, three ministries, four provinces and seven interest groups. However, *WL / Delft Hydraulics* takes full responsibility for the plan (see Figure 6.2).

The plan starts out with the assumption that water discharge levels in the long run could become higher than the levels assumed by Rijkswaterstaat in justifying the self-imposed limitations of the flood plains project. But the designers of *Rijn op Termijn* acknowledge that such higher discharge levels are very uncertain. They nevertheless come forward with their plan particularly to introduce a new type of thinking about future river basin management.

This new approach emphasises the importance of interconnecting various physical elements of the river basins. It considers interactions between surface water, ground water, quantity and quality of these waters, soils under and next to water bodies, ecosystems in the river basin, and the built environment. It provides ample space for organic, self-regulatory dynamics in the river basin.

More practically, the plan envisages changes throughout the Dutch Rhine basin, but its main feature is the reconstruction of the IJssel River that branches off the Rhine in the eastern part of the country. It suggests increased (2:7) channelling of water through the IJssel and the development of retention zones on agricultural land that can store floodwater to either subside into the soil or be flushed later on.

The arguments for the new role of the IJssel valley are manifold. First, the alternative of channelling more excess water through the flood plains of the river Rhine to the western part of the country is more expensive. The eastern part has more farmland, which is more suitable for periodic flooding than the dense system of residential areas, industrial sites and infra-structural networks in the west. Second government policy aim at decreasing the acreage meant for farming that, after all, shows a structural overproduction and remains heavily dependent on subsidies.

Third, the eastern provinces have in any case to deal with increased flood risk and organise for storing and flushing of excess water. Fourth, eastern ground water levels are lowering which creates increased shortages during dry summers. Fifth, along the IJssel wetlands and woods are planned that enrich the natural quality. Sixth, the enriched nature will attract additional tourists, which benefits local trades people.

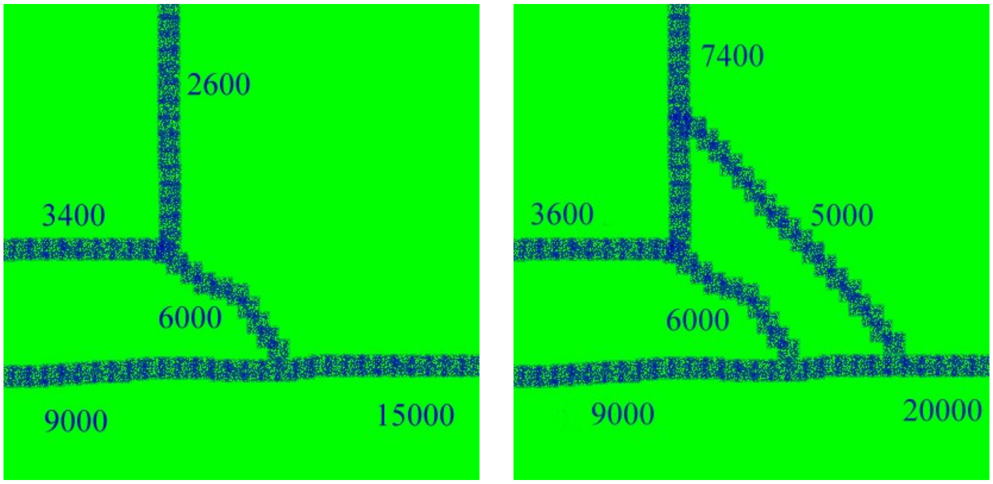

Figure 6.1 Current (left panel) and proposed future (right panel) distribution of the Rine's peak flow over its branches. The5,000 m^3/s branch is additional and only used in times of high water. It involves digging a new canal but largely relies on an earlier branch of the river. Source: WL/Delft Hydraulics, 1998.

6.6 First reactions to the green option

The authors of *Rijn op Termijn* emphasise that the proposed project is environmentally very beneficial in the long run but socially and politically risky in the short run. According to the public relations officer of the project, it drew attention from government bodies, newspapers, municipality administrators and interest groups (see NRC Handelsblad 1999). In general, as one informant states, civil servants find the plan too radical and hope that during their term they don't need to decide on such a far-reaching affair. National politicians lend a better ear to the plan and the Minister of Transport and Water has asked three advisory committees to include the *Rijn op Termijn* plan in their studies.

Again according to the public relations officer, reactions to the plan at the level of the IJssel region vary between extremes. Provincial politicians are interested but want to study the plan in detail before giving official statements about it. Representatives of inland navigators reject the plan because of reduced shipping possibilities on the IJssel. Nature conservationist organisations, on the other hand, strongly favour the turning of farms into lands and waters that are rich in bio-diversity.

Residents and farmers tend to have the *not in my backyard* (NIMBY) reaction, while asking why the poorer east should bleed for the west with its higher prosperity and government bodies located there. In addition, some farmers oppose the idea of exposing their land to increased flood risk, while others hope to receive ample compensations for giving up farming. On the other hand, as will be described below, the field study shows that local stakeholders are quite well aware of need for public measures and their personal interests in these measures.

The feelings of concern, mistrust and outright opposition are reinforced as the *Rijn Op Termijn* plan is designed by physical scientists without prior stakeholder consultation, or attention paid to compensation arrangements. A furious opponent of the plan is the mayor of the Twello municipality, halfway the IJssel river, who is also chairman of all river municipalities in The Netherlands. The designers of the plan will visit the Twello municipality council in order to discuss environmental, societal and financial details.

Figure 6.2 The proposed bypass (see also Figure 6.3) and restructured river IJssel. The light grey areas are currently flood-safe, but would occasionally flood in the proposed situation. Source: WL/Delft Hydraulics, 1998.

6.7 The Green River

The field study focuses on the local area where the plan *Rijn op Termijn* has designed a new connection between the Rhine and the IJssel. This connection is essential for the success of the entire plan. The first part of the IJssel Valley, with its dense settlement near Arnhem and Westervoort, does not allow for the extension of the water volume. Yet, channelling much more water through the IJssel is required to relieve the western part of the country. Therefore, a new connection has been opted that bypasses Arnhem and Westervoort and actually makes a shortcut from the Rhine upstream to the IJssel downstream (see Figure 6.2).

The bypass will be about 25 kilometres long and about two kilometres wide. No channel will be dug out; excess water will just inundate the area. Both existing and new dikes of 3-5 meters high will border the intended area. The bypass is not only meant for the flow and retention of excess water, but also to function as a nature reserve area or *eco-corridor* with an enriched diversity of trees, plants, animals and micro-organisms. This last function gives the intended bypass its name of *Green River*.

The Green River starts close to the German border, near the village of Spijk (see Figure 6.2). It runs to the north-west and emits in the IJssel near Giesbeek. The first part of this bypass is a system of old riverbeds (*strangen*) of the Rhine, and therefore called *Rijnstrangen* area. After some preliminary changes during the twentieth century, it was finally closed off from the Rhine by a dike near Spijk in 1959 and partly preserved as a nature reserve with sparse habitation. Several farmers were bought out by nature conservation organisations and moved to Canada, USA, Portugal, France, Germany or Poland. Figure 6.3 shows in detail how the new bypass runs north from the old river bed between the towns of Duiven and Zevenaar.

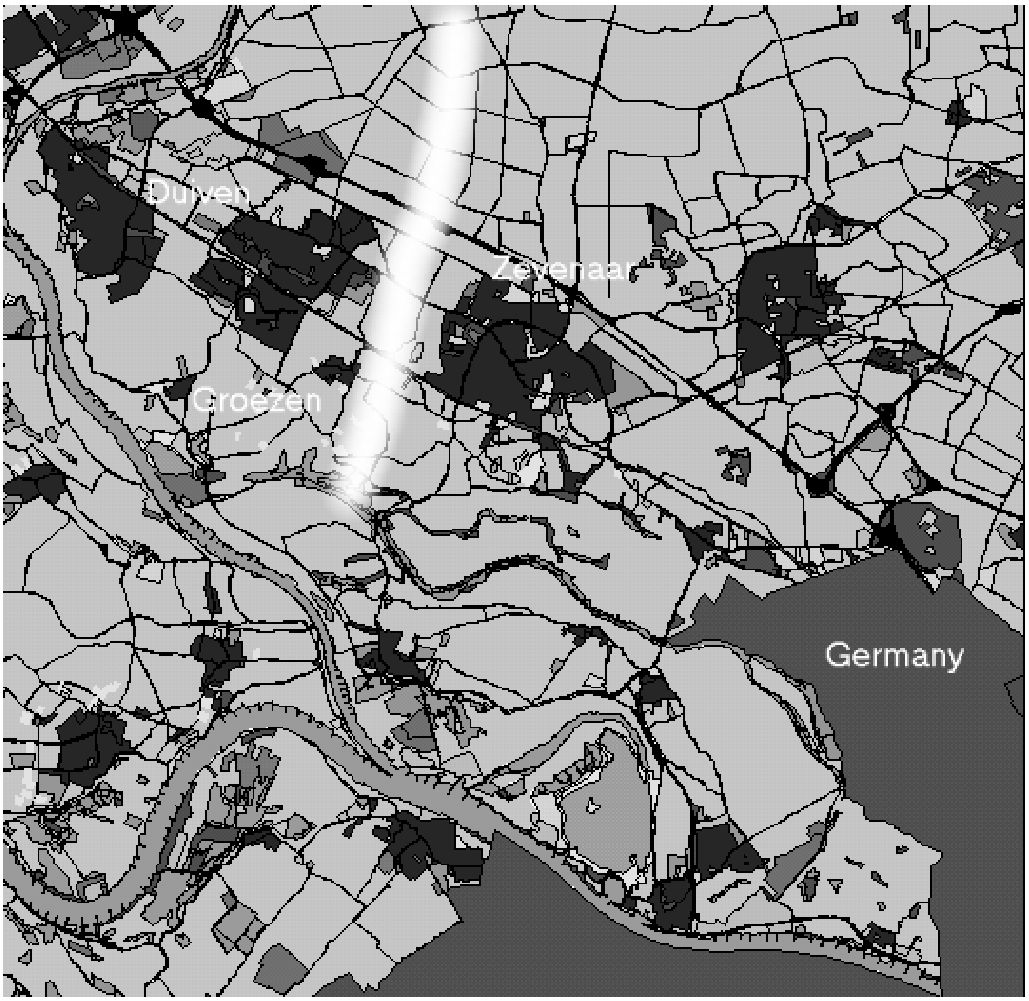

Figure 6.3 Helhoek and its direct environment. Helhoek is located between Duiven, Zevenaar and Groezen. The cloudy stripe represents the green river towards the river IJssel.

Compared to other parts of the radical *Rijn op Termijn* plan, opening up the *Rijnstrangen* area for excess water will not be too much of a problem. Some forty houses and farmsteads will have to disappear or face the risk of periodic inundation. Only minor roads cross the first part of the Green River; during periods of inundation small ferry services would facilitate local transport.

Realising the second part of the Green River, however, would be a major operation with serious consequences. The water would have to cross a chain of villages and the best place is in-between Zevenaar and Duiven, where the Green River will affect the least number of inhabitants. Nevertheless, here hundreds of families in and near the hamlet of Helhoek would have to leave hearth and home forever to give way for the Green River. The residents of the outskirts of Zevenaar and Duiven will come to face the new dikes of 3-5 meters high along the Green River (see Figure 6.3).

Bridge or tunnel constructions will be needed for the Green River to cross the railway and the highway to Germany and some local roads. Once flowing beyond this infrastructure and the hamlet of Helhoek, the water will broadly follow a streamlet and inundate sparsely populated farmlands before it enters the river IJssel near Giesbeek.

6.8 Invasion of Helhoek

For the local residents the alternative of being evicted would be to remain living in Helhoek with the risk of a flood once in 5-10 years. Nuanced protective measures can be taken in case the area around the houses will be submerged. However, submersions will not be the only things that come to Helhoek. A number of large infra-structural projects will be invading the locality. The national railway-company (*Nederlandse Spoorwegen*) plans three railways to pass through Helhoek in the near future. First, there is the so-called Betuwelijn, a freightrailway to Germany that is being constructed at present and will join the existing railway in Zevenaar. It will come to run through a new trench to reduce noise pollution for residents.

Second, the same railway trench may be broadened again for the high-speed railway line (*HSL* in Dutch, *TGV* in French) between Amsterdam and Cologne. Third, there is a plan to construct a northern branch of the Betuwelijn that may come to run right on the main street of Helhoek. Although the national government officially cancelled this plan in 1999, at the provincial level there are still forces that aim at continuing with it.

On top of that all, Rijkswaterstaat will broaden the highway to Germany that borders the north of Helhoek from four to six lanes and construct a new highway from south-west to north-east and connect that to the highway to Germany.

Although plans like that of the northern branch of the Betuwelijn may be reconsidered from time to time, some of these plans will certainly be implemented. However, these plans have no provisions to let the Green River by-pass flowing over or under the intended constructions. Yet, the *Rijn op Termijn* plan, and therefore perhaps the entire Rhine flood protection in the Netherlands in the future, depends on the realisation of the Green River.

So, in order to realise the *Rijn op Termijn* plan, its protagonists need to convince the powerful Nederlandse Spoorwegen and Rijkswaterstaat of the importance of the plan. These organisations will have to invest large amounts of money not only to let the Green river cross the *dry* infrastructures, but also to build the Green River with sophisticated technologies in order to accommodate the local population and allow the conservation of nature in and around Helhoek.

The authors of *Rijn op Termijn* may find support among the Gelderland provincial authorities, the Waterboard Rijn and IJssel, the municipalities involved, NGOs for nature conservation, as well as the tourist business. Over the heads of the Helhoek people, these probable protagonists may have to negotiate with the Nederlandse Spoorwegen and Rijkswaterstaat. But whatever result follows from their negotiations, the population of Helhoek is going to face major interventions in the form of railway and motorway constructions and, if the Green River is realised, periodic submersion of the hamlet or a complete relocation.

It is for these reasons that the following sections concentrate on how stakeholders in the envisaged Green River area, and notably Helhoek, regard their coping with the large infra-structural plans. The research has discussed the plan it with residents and other stakeholders who will be most affected by its implementation. It sheds light on their thinking of the future, including climate change, high water levels, water management solutions and the distribution of advantages and disadvantages.

6.9 In my backyard

This section contains citations in spoken language that indicate thinking of Green River stakeholders about how to deal with future management alternatives. In the words of Harriette Marshall, when writing about discourse analysis, these texts are repertoires as culturally embedded and socially communicated, shared systems of meanings, or versions of cognitive processes, actions, policies and other phenomena (1995:91-93).

'You see, if the government wants it, we can't stop it. The new railways are coming. The new motorways are coming. So, the Green River will also be coming. We, of course, wonder about the reasons behind this bypass project. Is it really needed? There are more floods, that is true, but the government allowed too many constructions in the flood plains. These should be removed and the flood plains deepened. Now, finally, they start doing something about it. That should be sufficient.

Will there be more rain in the future? Is that because of climate change? Listen, one professor says 'it becomes dryer', the other says 'it becomes wetter.' So, what do we simple citizens know about it. That's for the professors and the government to decide. Oh, is it not a plan of the government? Well, some people will get rich from it, isn't it?

Sure, we like to have a nature conservation area around here. We can go for horse riding, cycling, canoeing, and taking out the dog for a walk. Tourists will come and spend money, which is good for the local shopkeepers. But the risk of river floods is very small once the flood plains have been deepened.

We are not so afraid of floods. We have centuries of experience with the river. We all have mobile telephones nowadays (*we hebben tegenwoordig allemaal een GSM-etje*) so we know when the water comes. In the basement we put the machines on chocks (*opklossen*) to keep them dry. If the water level rises too high we simple drive away. Or we become just like Noah. We get in the boat and sail to the nearest hill (*we stappen in* *de boot en varen naar de Eltenberg)*. Only the immigrant families (*import*) don't know what to do exactly.

If this Green River project is really implemented the water will have to cross a number of motorways and railways. How are they going to arrange for that? And if they manage to build bridges or tunnels to allow the excess Rhine water to flow here, most of us will have to leave. We'll get financially compensated for that; we don't doubt that too much.

The real loss will be the quality of social life in this close-knit community. The immigrant families also came to appreciate the friendliness, the many flourishing associations (*het bloeiende verenigingsleven*) and mutual help of neighbours (*noaberplicht*). They work somewhere else and just wanted to live in the countryside.

Some of us may have to leave and get financial compensations for it. We don't doubt that too much. Others will stay without financial support and living in-between all the new constructions that are planned right here before the Green River might come. These people will be the real victims. They will live in *infra-structural islands*, being isolated and facing the monsters of progress.

We also like to get quickly to other places, but all these new highways and railways, my oh my, Holland is organised well enough with the present infrastructure. The Betuwelijn for freight transport is more an object of prestige for national and local politicians than economically viable or reducing road transport and air pollution. The northern branch is even less required. Only Germany is going to benefit. The construction works are planned without proper co-ordination. Building the Betuwe railway, and later on the High Speed Line along the same route will take twenty years. If they do it at the same time it takes only ten years. Rijkswaterstaat says that these projects have separate trajectories of preparation. The last project has to be adjusted to the earlier projects.

The officials also say that they have to deal with many locations where roads and railways will pass. So, why should they pay extra attention to Helhoek? But we think that they are just inflexible blockheads, not talking to each other, wasting millions of guilders of tax payers' money on extra salaries and commissions, and burdening the residents here with the nuisance of subsequent works under construction.'

These and other statements indicate two striking implications once the Green River would be developed. First, the relocation of probably the entire Helhoek population means the loss of precious social cohesion that has been preserved in the community so far. Second, the local stakeholders negotiate the terms of relocation as an well-organised group of people, with experience and skills gained in plans for earlier infrastructures. The next two paragraphs discuss these two implications respectively.

6.10 Social cohesion at stake

Helhoekers explain in different ways the high level of social cohesion and, as they perceive it, the good quality of social life in their community. One argument was that the wider area of the Achterhoek is known for a settlement pattern of small farmer families that reside spread out and as compensation revert to strong social organisation. Another argument is that Helhoek and the nearby village of Groessen are Roman Catholic communities surrounded by a majority of Protestant communities historically which brought the Catholic minority all the more together.

In order to prove that relative isolation of a village creates strong cohesion examples are given of fishermen's villages such as Volendam, Katwijk, Spakenburg and Urk. Here the perspective was aimed at the sea, connections with the inland population remained weak, and social cohesion was strong enough to keep the community traditional and secularisation limited.

To some extent, the arrival of ecological sustainability ideas harbours the risk of bringing submersion of such closely-knit communities. Though regretted by its proponents, to be certain, the *greening* of the Rhine river basin may bring the end of the Helhoek community. National and ecological interests will come to dominate and destroy local and social interests of which, according to the interviewees, social cohesion is the most precarious of all.

This cohesion shows in social contact that surpasses the functional, *single-stranded* interactions between a shopkeeper and a customer, a teacher and a pupil, or one neighbour and the other. Rather, *multi-stranded* relationships dominate in which people maintain contacts for a number of reasons and meet each other at many different occasions. Also, customs of mutual help exist among a large majority in the community. Though social control is rather far-reaching, it is not felt to be restrictive or suffocating but offering meaning, support and prevention of petty crime. It is actually described as being applied with a certain wisdom and friendliness.

Immigrant families are welcomed in direct personal ways but also with a welcome ceremony performed by a number of Helhoekers assembled for the occasion. Most newcomers appreciate this attention and become rapidly integrated in the community life. Just a few families declined the elaborate welcome and prefer to live more independently, which is rather well accepted or understood in the community.

Social events are not only organised to welcome immigrants but for other occasions as well. Winners of sports prizes are celebrated, sick people receive attention in adjusted ways, and old aged people are honoured at jubilees. A large number of voluntary associations are responsible for the organisation of these events. They either operate in the village of Groessen that includes Helhoek, or in the hamlet of Helhoek alone (see Table 6.3).

The central one is the Neighbourhood Association Helhoek (*Buurtvereniging Helhoek*). Other such associations in Groessen are of Diesakkers, Lijkweg, and De Woerd. The one in Helhoek exists 20 years, has 58 households as members, and conducts 5-6 annual events in addition to special events for children, adults, marriages, funerals and other *rites de passage* for people at important points in their lives.

Perhaps the most important festival period is in the third week of September when fun fair (*kermis*) is held. The festivities start with a mess in the church on Saturday at 6:00 PM. The local Riffle club conducts shooting contests on Sunday where all *real* inhabitants participate. The elementary school is closed so that the children can along with the adults join the full-day party in the honour of the shooting champion (*Schutterskoning*).

Table 6.3 List of associations in Helhoek.

1. Buurtvereniging Helhoek, neighbourhood association.
2. Catholic Rural Organisation KPO (Katholieke Plattelandsorganisatie).
3. Farmers' organisation GLTO (Gelderlandse Land- en Tuinbouw Organisatie).
4. Groups for various services in the Roman Catholic Church.
5. Groessen in Protest (GRIP), interest group dealing with plans for infrastructures.
6. Brass band St. Andries.
7. Show Band KDO.
8. Children's choral society.
9. Youth choral society.
10. Women's choral society.
11. Men's choral society.
12. Vita Nova, general choral society.
13. Riffle Club EMM.
14. Shooting association Irene.
15. Sportclub Groessen, soccer club.
16. Handball club.
17. Judo club.
18. Cycle club (occasionally organised).
19. Gymnastics club (occasionally organised).
20. Card playing club (occasionally organised).
21. Scouting club for young girls (kabouters).
22. Scouting club for young boys (welpen).
23. Scouting club for older boys (scouts).
24. Old age society De Bejaardenbond.
25. Youth society Rinoceros.
26. Charitas association Vincentius.
27. De Zonnebloem, association taking care of the sick at home.
28. Bearers' association, functioning at funerals, of about 25 men.
29. Children's committee.
30. Carnival association De Deurdraaiers.

The carnival association *De Deurdraaiers* holds an annual procession of about 25 floats and a party in a tent for about 2,000 people from the Helhoek and nearby villages. The Children's committee is active for the celebration of Queen's Day at April 30, and St. Nicholas at December 5th. The Charitas association *Vincentius*, collecting money from door to door about every week. Other associations organise regular and incidental events for religious purposes, to make music or to have sports games. Below is a list of the most important associations that are active either in Helhoek alone, or in both Helhoek and the village of Groessen.

The communities of Helhoek and Groessen, both being part of the Duiven municipality, are closely intertwined. If the Green River is implemented, Groessen is likely to be spared. Groessen is the larger one of the two villages with about 1,600 inhabitants as against about 200 in Helhoek. The common Roman Catholic Church is Groessen. The priest, serving in three village churches, resides there as well. Roman Catholicism is the only religion in Helhoek and Groessen, with an exception for some immigrant families in Helhoek; Groessen has no *import* families. Helhoekers depend on the family doctor living in Groessen. Most children go to the elementary school in Groessen. Secondary schools are in the nearby villages of Zevenaar and Duiven.

The inhabitants perceive the strong social cohesion in Helhoek as very positive. The frequent meetings and activities, including the joint efforts to prepare all these events, are felt to give much mental satisfaction. Privacy, on the other hand, is certainly appreciated for oneself and respected for others. The skills to maintain a proper balance between contact and privacy are consciously applied, discussed and reconsidered, and after all constitute social capital that has been accumulated by trial and error over a long period of time.

The remarkably strong social cohesion in Helhoek does not mean that all internal relationships are full of harmony. It means that both harmony and conflict exist in the local network of dense, multi-stranded relationships. The local cohesion also does not mean that all external relationships are discordant. It means that both harmony and conflict can occur in the external contacts. At the same time, Helhoekers have the clear-cut possibility of common activities in the outside world at their disposal.

6.11 Social cohesion against interventions

Disregarding the envisaged Green River, the local stakeholders deal already with a number of infra-structural works that are either being implemented or planned. In Helhoek and Groessen the pressure group *Groessen In Protest* (GRIP) is busy studying the Green River plan along with other plans to redesign the Rhine river basin. GRIP was originally established in 1990 in order to deal with the planning trajectory for the Betuwelijn, the freight railway from Rotterdam to Germany. A number of houses, farms, gardens and small enterprises were to be left. The potential evictees and other local stakeholders to be affected by the new railway united in the action group. They developed an agreement that all members would defend interests jointly as long as possible whereas if it came to negotiate individually about damage and compensation they were free to do so, with the help of specialised lawyers, and without being blamed by the others.

The approach of joint action to be followed by individual action worked out well in dealing with the project trajectory for the Betuwelijn and will be applied again in preparatory stages for other railways and motorways and, if it comes, for the Green River. During the period of 1999-2000 GRIP co-ordinated a joint protest of 14,000 notices of objection against the track for high speed trains, the *Hoge Snelheids Lijn (HSL)*, from Arnhem to Germany.

One of the consequences of sending notices of objection, for that matter, is that each sender is placed on mailing lists of government bodies involved to inform local stakeholders about infra-structural projects. It is because of this policy that large numbers of stakeholders receive detailed information about relevant plans. In addition, they are informed by the chairman of GRIP, who is a member of the sounding board group of stakeholders for *Rijkswaterstaat*, the national government body for *wet* and *dry* infrastructures.

GRIP also operates to raise awareness about the possible construction of the new infrastructures, such as the Northern Branch of the Betuwelijn railway. GRIP organised a cycle trip of 25 km in the area where this Northern Branch will come in the summer of 1999. It applied visual demonstration of effects for the cyclists to see on the way. The slogan of the action was *We worden verkocht voor een appel en een ei*, which means literally *We are sold for an apple and an egg*, or *We are sold for a song*. A fruit grower and a dairy farmer, to be affected by the Northern Branch, co-operated to the action by symbolically rewarding the cyclists who completed the trip with an apple and an egg each.

Groessen has many fruit growers with a minority of stockbreeders. Helhoek still has only six farmers: five dairy farmers and one pig farmer. Three other farmers have left recently. In the southern part of the intended Green River, near the present river Rhine, farmers were bought out to give way to the new nature reserve area called Rijnstrangen. One farmer went to Canada and three settled down in the USA. Most of the remaining farmers are member of the Farmers and Horticulturists Organisation LTO (*Land- en Tuinbouw Organisatie*). The LTO is well organised and provides strong support to farmers who negotiate compensations.

Helhoek has a number of 30-40 small-scale enterprises that would incidentally be flooded once the Green River area is implemented and therefore will have to move to other places. Most of these enterprises are concentrated in an *industry park* in the eastern part of Helhoek. Other enterprises are shops and freight carriers. These entrepreneurs are expected to strongly negotiate financial compensations.

Residents will also negotiate cleverly but with another sense of loss. Original residents will feel that the loss of social life can hardly be compensated with money but negotiate in a balanced way. Newcomers, *the import families*, did start to appreciate the value of local community life and also feel that to be at stake. However, while keeping their jobs in nearby urban centres they did settle in Helhoek especially for the quite natural environment. They may first oppose fanatically any plan for relocation and later on negotiate the terms of relocation with the same fanaticism.

In more general terms, how may Helhoekers react when the Green River is going to be realised? First, some of the old residents may reflect the historical situation in which people were rather docile and let them tell what to do by authority figures such as the priest and the landlord. However, the majority of the population has quite some fighting spirit, with organised farmers and the younger generation in front. Moreover, Helhoekers have gained experience with earlier plans for large infrastructure works where the learned to operate as a well-organised group of people.

Second, it is not likely that they will fight like lions against everything new or external. It is the type of social sophistication related to the social cohesion of Helhoek that may guide contacts with the planners of the Green River. Helhoekers maintain a multitude of external contacts in the present day and there also demonstrate, with variations, a certain sense of social wisdom or sophistication. The local stakeholders are certainly willing to consider the needs of wider society and ecology, while at the same time assertively defend their stakes.

A third type of reaction by Helhoekers to a possible Green River project in the future would be that they clearly see their interests at different levels of scale. They themselves as well as others, such as relatives and colleagues, have stakes in the quality of large-scale infrastructure, and economic and ecological sustainability. They are not only influenced by but also push forward wider social trends such as democratisation of planning and decision making, internationalisation of river basin management, naturisation of civil engineering and pursuing integration of environmental parts. Table 6.4 enlists the divergent or conflicting interests for each group of stakeholders that the actors consider simultaneously in order maintaining balance.

Table 6.4 Divergent interests of different stakeholders.

Stakeholders	Divergent interests
General	Local and national interests
	Long-term and short-term interests
	Economic and safety interests
	Green vs. technocratic orientation
Residents	Lower real estate prices vs. nature reserve nearby
	Long-term and short-term interests
	Green vs. technocratic orientation
Farmers	Financial compensation for relocation
	Loss of social cohesion
	Green vs. technocratic orientation
Entrepreneurs	Financial compensation for relocation
	Worries about moving
Commuters	A15 noise, landscape pollution
	Less rush on the way to work in the Arnhem area
Socialists	Green vs. technocratic orientation
Conservatives	Green vs. technocratic orientation

6.12 The Polder Model

The fourth type of reaction by Helhoekers to a Green River project has to do with conflicts between stakeholders and can be described as shaped by the *Polder Model*. This model indicates the Dutch cultural feature of a predominance of compromise over confrontation (consensus seeking). The Netherlands are even known abroad for this *Polder Model* that shapes important decision making processes through negotiations instead of conflicts that can lead to deadlock situations or do more damage to the common good then necessary. The *Polder Model* is notably famous for bringing together trade unions, employers and the government annually to decide on wages levels while considering employment rates, inflation and other macro-factors.

This *Polder Model* can be seen as part of a wider trend towards increased democratisation and co-responsibility in Dutch society. It goes hand in hand with high levels of education and information among citizens, the *civil society*, and a diminishing gap between government circles and local communities with regard to felt needs and concerns. The emergence of this *Polder Model*, imbuing the entire Dutch society, is also likely to affect interactions between local and external stakeholders about a futuristic Green River plan.

Perhaps the best example of the *Polder Model* applied in Helhoek is the project on perspectives of various groups of stakeholders regarding the Green River organised by a school in the bordering village of Zevenaar. This school, the *Liemers College*, more or less comparable to a high school, is for children of 12-17. Teachers and students of the section for preparatory scientific education (VWO) organised a study to assess the Green River plan as it was published in the media.

Students made biological and geographical studies to see environmental consequences and design smart solutions for having both a nature reserve area and maintain living conditions for residents. The findings were presented in an exposition in the school building. Other students interviewed a number of stakeholders to find out various interests and perspectives, including from residents, farmers, industry, transport, nature conservationists and municipality officials. The students simulated the complex communication about different interests in a workshop, in order to learn remaining in contact with each other even if stakes and opinions were widely diverging.

6.13 Abbink's backyard

However proper as the above generalisations may be, they tend to conceal what can happen to individual stakeholders. The case of the farmer's family Abbink living at the northern of Helhoek provides an illustration of such particular details. According to the judgement of the researcher, aiming at the minimisation of subjectivity and maximisation of integrity, their case can be seen as rather representative of the farming community in the envisaged Green River area. In an extensive interview the family members explained their responses to earlier government interventions that may indicate how they would respond to the construction of the Green River. Table 6.5 presents a number of such interventions and how these have affected the farm and the family.

Table 6.5 The Government and Farmer Abbink.

Government intervention	Effect for Farmer Abbink
Completed	
Redistribution of land (*herverkaveling)*	Appeared to benefit development companies
High voltage lines	Radiation. Risk of electrification. No information
Gas pipelines	Cracks in the walls. Not repaired
Faster N810 road	Casualties
Acidic manure reduction	Too costly. Risk of bankruptcy
Greening of agriculture	Low-protein hay
Greening policy in general	Agricultural education includes the environment
Possible in near future	
Broadening highway A12	Disconnection from land at other side of road
Industries along A12	Disconnection from land at other side of road
Highway A15 from Betuwe	Right through the stable
Noordtak freight railway	Right through the kitchen
Possible in far future	
Green River	Relocation of the family and farmstead

The family enlists the government interventions that they have faced over the last decades. On the one hand, they appreciate most of the measures as aiming at the common good and benefiting the family as well. On the other hand, they point at negative consequences in the form of material losses, newly created dangers and uncertainties, lack of financial compensations, and disrespect for their personal feelings.

On the most serious complaints is that decisions about possible interventions are often postponed or several times reversed. This pattern is felt as creating *swords of Damocles* that hang over their heads over prolonged periods while they can fall on them any moment. Will the family really have to move entirely to a new location, yes or no? Will they have to move this year, or only after ten years? Should they decide to move before the children of the eldest son go to school? Should they invest in a high-tech cow-stable in Helhoek or in their new location? Can they afford a delay considering changes in the dairy market and agricultural politics of the European Union?

6.14 Structural conflicts

The generalisations about Helhoek's social sophistication and the Dutch Polder Model not only conceal individual problems, but also the actual conflicts that are battled out locally and may affect a future Green River project. The relocation needed for the project would not be the first one in the Netherlands and lessons can be learned from earlier ones. In several instances, numbers of houses, firms and even entire communities have been removed to make space for new infrastructures in the Lowlands. In order to extend the harbour areas of Rotterdam, Antwerp and Amsterdam not only scattered buildings but also complete hamlets and villages have been demolished and populations relocated over the past few decades. A few individuals and communities, such as the strongly vocal artists' hamlet of Ruigoord near Amsterdam, have been able to resist pressures from the government on a permanent basis. At best, it can be inferred that residents, farmers and entrepreneurs have developed knowledge and skills to exert more compensation from government departments in exchange for their relocation and other damages suffered.

For comparative reasons one may think of large infra-structural projects in other societies, such as the complex of dams in the Narmada river basin and the Theri Dam in India, or the Three Gorges Dam in the Chang Jiang river in China (Roy 1999). Here, in Asia, the distance in social power, level of information and material interests of planners and construction companies on the one hand and local populations on the other is about as vast as the projects and the damage that they inflict on evictees and ecology. Such social distance is rather reduced in the Netherlands, which contributes to easier and more constructive types of negotiations between planners and population.

Nevertheless, several types of conflict between parties are observed that occur at present and may occur when the Green River would be implemented (see Table 6.5). There are notably conflicts of interest between parties, and conflicts of interest for individual parties themselves. Farmers are involved in several structural conflicts of interest with other parties. Two explanations for prevail. First, farmers are an effectively organised professional category and operate both within and against the societal establishment with keenly developed skills such as of organisation, lobbying, publicity and physical activism. Second, farmers are under high pressure from both the government and the public opinion to reduce their production and environmental pollution, and produce healthier food. They partly accept these demands as reasonable, and partly as in conflict with demands to heavily increase production and productivity in the decades immediately after the Second World War.

Perhaps the fiercest conflict exists between farmers and environmental activists. A notorious conflict arose with the late, radical activist group *Lekker Dier* that urged for better living conditions for the domestic animals. The group deployed physical confrontation tactics in the style of Greenpeace actions and managed to draw similar attention from the press. Farmers however felt deeply offended and misunderstood by the aggressive interventions on their territory and in their operations.

Table 6.6 Conflicts of interest between parties.

Conflicting parties	Stakes
Government departments	Power
Government vs. local population	Top-down measures vs. local interests and initiatives
Country vs. local population	River basin management vs. ‘not in my backyard’ (NIMBY)
Technocrats vs. *postmodern* managers	Large project construction vs. long-term ecological approach
Green officials vs. farmers	Green farming measures vs. *modern* farming
	Nature conservation vs. nuisance for neighbouring farmers
Activists vs. farmers	Animal protection vs. economic productivity
Residents vs. commuters	Peace and quite vs. noisy and dangerous highway traffic

Farmers also feel misunderstood by nature conservation officials such as belonging to the Ministry of Agriculture and Nature Conservation or the government forest department *Staatsbosbeheer*. New regulations are issued to stimulate environmentally friendly farming but farmers often feel these regulations reveal a lack of proper knowledge of affairs. Also, new conservation projects are implemented that, according to farmers, often show a lack of knowledge or consideration with regard to the affects for farmers. Just south of Helhoek, a nature conservation area is created by Staatsbosbeheer and foxes are put out. These foxes, it is claimed by farmers, do not restrict themselves to the boundaries of the area but go on nightly prowls to neighbouring farmsteads at distances of tens of kilometres.

6.15 Conclusions

This field study identified responses of stakeholders to future management of the Rhine River basin, notably to plan *Rhine In The Future*. This plan foresees the construction of a bypass between the rivers Rhine and IJssel, the *Green River*. The Green River area would be flooded during high water discharges. The inhabitants of the area, notably in the village Helhoek, would be permanently evicted for their safety and in order remove obstacles to the flow of water.

On the whole, the local stakeholders were quite well aware of actual and planned interventions and the related arguments given by the government. They have serious doubts about the magnitude of climate change and the predicted higher discharge levels in the rivers. They therefore doubt the need for a bypass from the Rhine to the IJssel, though appreciating the construction of a nature reserve area. They mostly suspect technologists and policy makers concentrated in and around the national government centre in The Hague: 'The Hague people have personal interests in large construction works.'

The 'not-in-my-backyard' (NIMBY) reaction was not found to be very strong. As indicated in Table 6.7, local stakeholders consider contradicting interests for themselves in a rather balance way. Also, conflicts that would make them opponents to other parties tended to be treated rather sensibly. Another type of balance that operates has to do with emerging social trends, such as naturisation and democratisation. Local stakeholders are not only passively influenced by these trends, but also contribute actively to them and are therefore open to new arguments and material the implications 'in their backyard'.

Table 6.7 Stakeholder responses.

Doubts about: - Climate change - Much higher discharge levels - Need for bypass - Personal interests in 'The Hague'
Awareness of contradicting interests: - Local interests vs. national interests - Economic interests vs. safety interests - Economic interests vs. nature interests - Comfort vs. nuisance of intra-structures

Once the Green River would really be prepared and constructed, it is expected that newly immigrated families would protest more vocally and effectively. 'Old' families would suffer more from the loss of social cohesion and attachment to the soil but give in earlier but. This does not mean that they would depart without struggle. Examples of such resistance are found during the preparation of the Betuwelijn railroad construction. They main requests to the government bodies responsible to large infra-structural works is to first interact with them, acquire knowledge of their interests, and decide clearly and only once in order to avoid that 'uncertainties eat you up'. In response they would be quite co-operative, help avoiding mistakes and contribute to finding technical solutions (see Table 6.8).

Table 6.8 Implications of relocation plan for Helhoek.

Resistance or negotiation: - *New* families will concentrate of resistance - *Old* families will concentrate on negotiations
Negotiations will be based on: - Strong social cohesion - Experience with dry projects - Reasonableness, Polder model - Trust in getting full financial compensation
Felt costs: - For those who remain: infrastructure islands - For those who may have to leave: uncertainty, Damocles - Loss of social cohesion, *naastenliefde*, *noaberplicht*
Requests to the government: - Interact with us - Know our interests - Decide clearly and only once

6.16 Recommendations

A policy scenario for the maximum local acceptance of a Green River plan is summarised in Table 6.9. The government should convince local stakeholders with proper arguments that the Green River bypass is necessary. The social trend towards naturisation should mature more and be able to overrule other interests. Government officials have to learn how to interact ‘vertically’, notably to listen to local stakeholders and respect their interests. Decisions should be once and for all. Municipality councils should be involved as they function with much local knowledge and ability to reach compromises. The provision of financial compensations, and top-down information and education should be kept at present levels or improved.

Table 6.9 Scenario of maximum local acceptance.

Actors	Activity	Status
Government-population	Shared sense of urgency	Absent
All stakeholders	Shared vision about naturisation	Absent
National government-local stakeholders	Two-way vertical interactions	Absent
	Official knowledge of local interests	Insufficient
National government	Decisions clear and only once	Not happening
Municipality councils	Consensus building through direct interaction	Happens; little bearing
National government	Financial compensations	Good examples available
Government bodies	Provision of information	Happens
Mass media	Provision of information	Happens
Schools	Education in environmental awareness	Happens
	Education in multi-stakeholder perspectives	Happens

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Appendix 6.I Methodology

This study applies the *system-oriented* approach, by looking at interactions between stakeholders that create the commonalities in the language and the cultural cement that bind the actors. This approach contrasts with *actor-oriented* stakeholder studies that collect data of individual actors as if they were isolated units, and statistically process these data at an aggregate level. To be certain, the present study does include divergent perspectives and interests of stakeholders and stakeholder groups, but does not regard such divergence as the only part of social reality that counts (Van der Werff 2000).

Nearly all cited texts were given in response to questions asked by the researcher. Direct speech is used in order to emphasise the subjective, though shared, story lines that were found to predominate in Green River area. The citations in spoken language indicate thinking of local stakeholders about how to deal with future management alternatives. In the words of Harriette Marshall, when writing about discourse analysis, these texts are repertoires as culturally embedded and socially communicated, shared systems of meanings, or versions of cognitive processes, actions, policies and other phenomena (1995:91-93).

Data were collected through study of documents, holding of interviews (see Table 6.I.1), enquiries on the phone, and observations in the Green River area and Helhoek. Interactions were maintained with Delft Hydraulics, the pressure group GRIP, and the students' project of Liemers College in Zevenaar. The research was presented and discussed in the Netherlands, England, Spain and India (see Table 6.I.2).

Table 6.I.1 Number of interviews held.

	By phone	Personal	Total
Local farmers	1	4	5
Local residents	0	7	7
Regional informants	1	6	7
Key informants	5	2	7
Total	7	19	26

Table 6.I.2 Presentations held about the research.

1	EU Research Project SIRCH, Biannual Meeting	London, England	September 1999
2	Institute for Environmental Studies (IVM), Vrije Universiteit	Amsterdam, The Netherlands	December 1999
3	Centre for Development Studies (CDS)	Thiruvananthapuram, India	February 2000
4	State Committee on Science, Technology and Environment	Kerala, India	February 2000
5	EU Research Project SIRCH, Biannual Meeting	Madrid, Spain	March 2000
6	Waterloopkundig Laboratorium/ Delft Hydraulics	Delft, The Netherlands	May 2000
7	Dutch Research School for Environmental Sciences (SENSE)	Ede/Wageningen, The Netherlands	May 2000
8	Programme for Environmental Policy Analysis, IVM	Amsterdam, The Netherlands	October 2000
9	Faculty of Earth Sciences, Free University	Amsterdam, The Netherlands	November 2000

7. Scenarios for the dutch Rhine and Meuse delta: climate, floods, income and the population

Richard S.J. Tol[47]

7.1 Introduction

The future will be different from today. How, we do not know. But we are not entirely groping in the dark. Predictions can be made, but is often more useful to use scenarios. Scenarios are internally consistent descriptions of not implausible future developments (*e.g.* Tol, 1998). This paper presents a number of scenarios for the Dutch Rhine and Meuse delta, with particular reference to future flood risks. Because the Netherlands is only a small country, there is hardly any link between the climate scenarios – which are global – and the socio-economic scenarios – which are national.

Section 7.2 presents scenarios for temperature and precipitation. Section 7.3 discusses the implications for river discharges, and estimates of changes in flood and drought damages. Section 7.4 continues scenarios for population, economy, technology and flood management. Section 7.5 concludes.

7.2 Scenarios for temperature and precipitation

Scenarios of climate change are the obvious starting point for a study into the implications of climate change of river flood risks. The weather variables that are most relevant for river floods are precipitation and temperature, as the latter drives evaporation. Wind speed and direction, barometric pressures and sea level rise are also important, because the discharge of river water to the sea may be slowed down. Wind and pressure scenarios are hard to obtain, however, and published estimates of the ‘backwater’ effect of sea level rise on river discharges are few.

Climate change scenarios consist of a number of components. Emissions of greenhouse gas depend on population growth, economic growth, and technological progress. Greenhouse gas emissions change the composition of the atmosphere. Degradation of atmospheric gases is a complex process, and climate change may well alter the flows of carbon between atmosphere, land surface and ocean. Atmospheric change leads to climate change. This complex constellation is captured, in a simplified form, in the COSMIC model (Schlesinger and Williams, 1998). The model allows the user to combine a range of emission scenarios, a range of parameters governing the sensitivity of climate to atmospheric change, and a suite of geographic patterns of temperature and precipitation changes from diverse General Circulation Models. Results are given for countries. The COSMIC model is the basis for the scenarios presented below.

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Figure 7.1 displays a scenario for the monthly increase in temperature in the Netherlands for the years 2020, 2050, and 2100. Temperature rises throughout the year. The increase in the annual mean temperature is about 2.5°C. Figure 7.2 displays the temperature difference in 2050 according to the scenario of Figure 7.1 together with estimates of the minimum and maximum temperature change. Although there is a slight chance that temperature will not change much (associated with, *inter alia*, low carbon dioxide emissions, high emissions of sulphates), there is also a chance that temperatures will increase much faster.

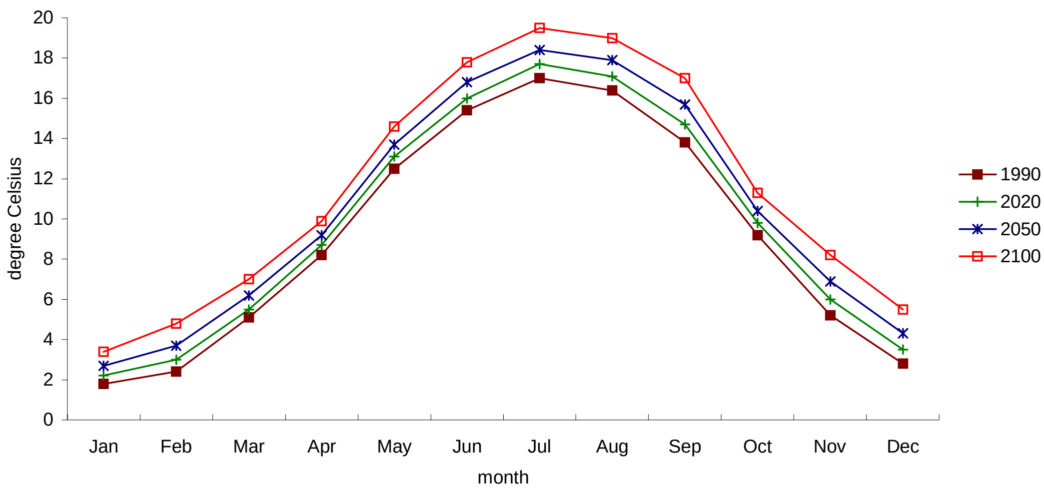

Figure 7.1 Monthly average temperatures in The Netherlands. Source: COSMIC (carbon dioxide emissions: S4 scenario; climate sensitivity of CO_2: 2.5; sulphate emissions: middle scenario; climate sensitivity of SO_4: -1.0; GCM: UIUC).

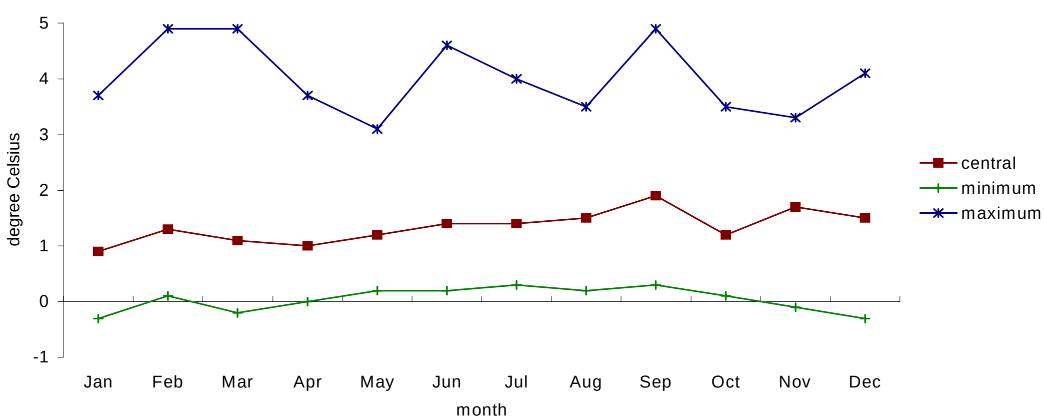

Figure 7.2 Monthly average temperatures in The Netherlands in 2050 as deviation from 2050. Source: COSMIC (minimum-central-maximum; carbon dioxide emissions: S1-S4-S7 scenario; climate sensitivity of CO_2: 1.5-2.5-4.5; sulphate emissions: high-middle-low scenario; climate sensitivity of SO_4: -1.2 - -1.0 - 0.0; GCM: CCC-UIUC-GFDL).

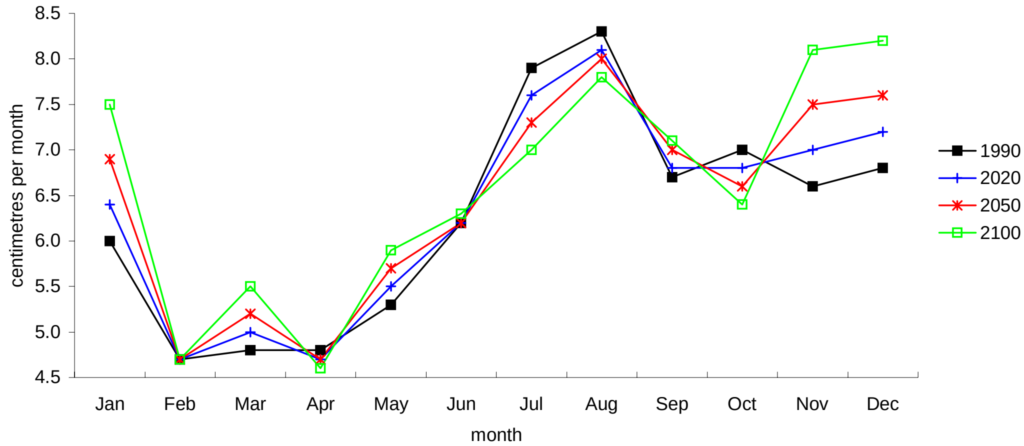

Figure 7.3 Monthly cumulative precipitation in The Netherlands. Source: COSMIC (carbon dioxide emissions: S4 scenario; climate sensitivity of CO_2: 2.5; sulphate emissions: middle scenario; climate sensitivity of SO_4: -1.0; GCM: UIUC).

Figure 7.3 displays a scenario for the monthly rainfall. According to this scenario, there is a slight increase in annual rainfall (3 mm in 2100). Summers get drier though, and winters wetter. Figure 7.4 displays the difference between 1990 and 2050 of this scenario, together with estimates of the minimum and maximum change. In the minimum scenario, it will get drier throughout the year, but especially in summer. The maximum scenario describes a situation in which it gets substantially wetter throughout the year.

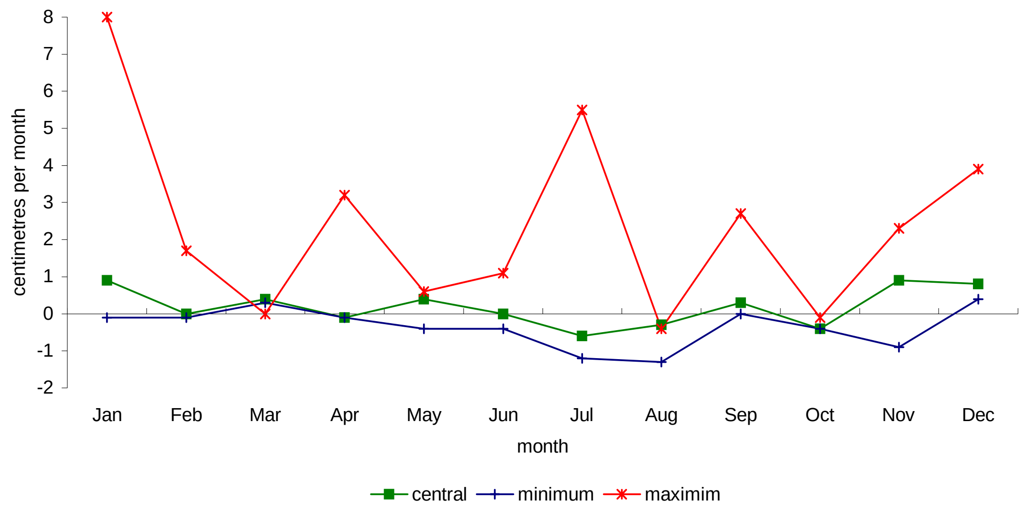

Figure 7.4 Monthly cumulative precipitation in The Netherlands in 2050 as deviation from 2050. Source: COSMIC (minimum-central-maximum; carbon dioxide emissions: S1-S4-S7 scenario; climate sensitivity of CO_2: 1.5-2.5-4.5; sulphate emissions: high-middle-low scenario; climate sensitivity of SO_4: -1.2 - -1.0 - 0.0; GCM: BMRC-UIUC-POLLD).

7.3 Scenarios for changes in river discharges, and associated impacts

Changes in precipitation and temperature obviously influence river flows, but not in a straightforward manner. The amount of water follows from the balance between precipitation and evapotranspiration. Water moves fast in certain parts of the river catchment, and slowly in other parts. A model is required that describes the important features of the river catchment. Such models are unfortunately scarce.

Kwadijk and Middelkoop (1994) developed such a model for the river Rhine, called RhineFlow. RhineFlow is a GIS-based water balance model, operating at a monthly time step. A statistical relationship connects monthly average discharge with peak discharge.[48] A warming of some 3.5°C and an increase in precipitation of about 9% would increase the once-every-two-years flood from a peak discharge of 6,750 m^3/s to one of 7,500 m^3/s. The discharge of the once-every-ten-years flood would increase from 9,500 m^3/s to 10,000 m^3/s Floods that now occur about once in every ten years would then occur once in every five years, and floods that currently occur every 100 years would have a return period of 50 years. At the moment, the river dikes in the Dutch Rhine delta are designed to withstand the 1/1,250 year flood, which has a discharge of 14,500 m^3/s at Lobith. The design discharge could increase by 1,500 m^3/s, corresponding to a rise in the maximum water levels of 45 cm.

48 A similar model for the river Meuse is being developed.

The Commission Water Management in the 21st Century (Tielrooy *et al.*, 2000) also developed scenarios for drought and floods for 2050, reproduced in Table 7.1. For the year 2100, numbers need to be doubled.

Table 7.1. Flood and drought scenarios for the rivers Rhine and Meuse for 2050.

	Current	Minimum	Middle	Maximum
Temperature		+0.5ºC	+1.0ºC	+1.5ºC
Precipitation, annual	700-900 mm	+1.5%	+3.0%	+6.0%
Precipitation, summer	350-475 mm	+0.5%	+1.0%	+2.0%
Precipitation, winter	350-425 mm	+3.0%	+6.0%	+12.0%
Rainfall intensity		+5.0%	+10.0%	+20.0%
Evaporation	620-720 mm	+2.0%	+4.0%	+8.0%
Sea level rise		10 cm	25 cm	45 cm
Summer discharge, Rhine	2100 m^3/s	-1 – -4%	-3 – -9%	-5 – -19%
Design discharge, Rhine	16000 m^3/s	16400 m^3/s	16800 m^3/s	17600 m^3/s
Apr-Jul discharge, Meuse	142 m^3/s	+1 – 8%	+1 – 17%	+3 – 34%
Aug-Sep discharge, Meuse	142 m^3/s	-1 – -2%	-1 – -3%	-1 – -7%
Design discharge, Meuse	3800 m^3/s	4000 m^3/s	4200 m^3/s	4600 m^3/s

Source: Tielrooy *et al.*, 2000.

Schuurman (1995) finds that a 10% increase in winter precipitation and a 2°C increase in temperature would increase the annual average damage of flooding in the South Limburg Meuse Valley from DGl. 9.9 to 21.8 million. This is without population or economic growth, without changes in urbanisation, and without countermeasures.

More people and more properties would mean that flood damages would increase further. Since Schuurman's estimates only take property damage into account, one may assume that flood damage is approximately linear in the number of people and their income. However, population density affects the run-off properties of the catchment. Essentially, people convert soft surfaces (grassland, forest) to hard surfaces (asphalt, concrete) so that less water is kept at the land, and more water is in the river. Schuurman (1995) reports that urbanisation would increase the flood damage from DGl. 9.9 to 10.6 million without climate change, and from DGl. 21.8 to 27.1 million with climate change. Climate change and urbanisation have a synergistic effect.

The hydrological model underlying the estimates of Schuurman (1995) is very similar to the hydrological model used by Kwadijk and Middelkoop (1994) to estimate the impact of climate change on Rhine floods. However, the flood risk situation along the Meuse is entirely different from the Rhine. There are polders along the Rhine, while there are hills along the Meuse. So, while higher discharges would imply more frequent and more extensive floods for the Meuse, higher discharges would imply a higher risk of dike failure along the Rhine, changing the frequency of floods rather than the intensity.

Chapter 2 gives an indication of the importance of inland shipping. The RhineFlow modelling has shown that climate change enhances the risk of persistent droughts with corresponding low water depth. This will hinder inland navigation. Middelkoop and van Deursen (2000) mention that by 2050 transport costs my increase in the order of 10% (costs per tonne). Depending on climate scenario and a scenario for economic development, annual costs of transport on the river Rhine between Rotterdam and the German hinterland rise with € 80 million – € 600 million.

7.4 Population, technology, economy, and water management

The population of the Netherlands is expected to increase from the current 16 million or so to about 18 million in 2030 and stabilize from then (CBS, 2000). Where these people will live is less certain. Figure 7.5 shows the current distribution of the Dutch population. The demand for living space per person is expected to continue to increase, as is the demand for 'green' environments. The ageing of the population will lead to a further decoupling of living and working areas, while the 'new economy' will reduce the need for industrial and service agglomerations (VROM, 2000).

Technology is likely to continue to progress. Recently, attention shifted from civil to ecological engineering, that is, water management and nature restoration combined. Ecological engineering being a recent development, technological progress should be fast.

Technological progress could also considerably change river navigation, under pressure from environmental concerns and competition by rail and road transport. Upscaling and telematics could give rise to river transport modes that rely less on wide, deep and straight canals, and more compatible with 'natural' rivers.

Average income is likely to increase. CPB projects per capita income to rise between 1.5% and 3.0% per year. This is unlikely to affect flood risks directly, although richer people have more properties at risk. Richer people also tend to spend more on preventing natural disasters such as floods, a trend dubbed the 'zero risk' society.

Four trends in flood management are described in Van der Grijp and Olsthoorn (this volume): integration, democratisation, naturisation and internationalisation. These trends are expected to continue. Integration involves the joint management of diverse but related issues. It used to be the case that water management was compartmentalised in flood management, navigation policy, drinking water management, and so on; at the moment, water management is more comprehensive. In the future, water management and land use planning may be integrated. Democratisation involves the gradual move away from a technocratic bureaucracy governed by a national government to more direct democracy at local levels. Naturisation is the increasing recognition of nature and landscape values, and the increasing use of 'ecological engineering' in lieu of civil engineering. Internationalisation is the tendency towards river basin management as opposed to the current, national management of water.

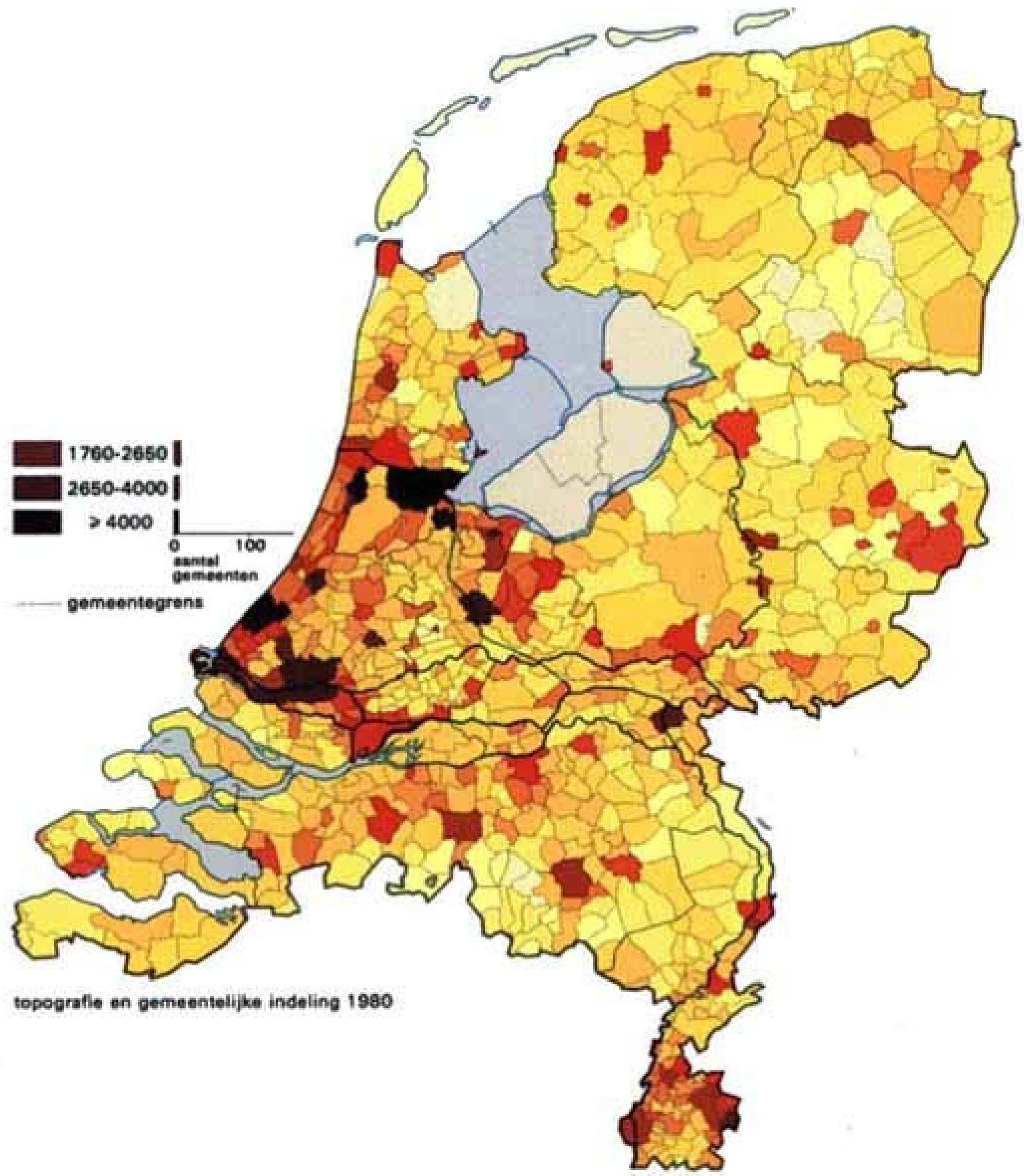

Figure 7.5 Population density per municipality. Source: SWAN, 2000.

7.5 Conclusions

This chapter presents scenarios. Essentially, scenarios are internally consistent sets of assumptions. As such, there is little to conclude. We look at the interplay of the climate and social scenarios in Tol *et al.* (this volume).

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8. Adapting to climate change: A case study on riverine flood risks in the Netherlands

Richard S.J. Tol[49], Nicolien M. van der Grijp[50], Alexander A. Olsthoorn[49] and Peter E. van der Werff[49]

Abstract

Climate change may lead to an increased risk of river floods in the Netherlands. However, the impacts of changes in water management are even larger, whether they enhance or reduce flood risks. Therefore, the abilities of water management authorities to learn that climate and river flows are changing, and to recognise and act upon the implications are of crucial importance. At the same time, water management authorities respond to other trends, such as the democratisation of decision making, which alter their ability to react to climate change. This complex of interactions is illustrated with changes in river flood risk management for the Rhine and the Meuse in the Netherlands over the last 50 years. A scenario study is used to seek insight into the question whether current water management institutions and their likely successors are capable of dealing with plausible future flood risks. Structural solutions to future flood risks are feasible, but require considerable political will and institutional reform.

8.1 Introduction

Studies of the impact of climate change often ignore adaptation[51], and studies that include adaptation often follow simple approaches under a *ceteris paribus* assumption (cf. Tol *et al.*, 1999, for an overview of the literature). This may well be inappropriate, because people's relations to climate tend to change anyway. Factors such as technology, wealth, and land use are only weakly related to climate but nonetheless shape responses to climate change. Therefore, in order to better understand reactions to climate change, we must study the institutions that channel people's perceptions and intentions into actual responses to expectations of climate change.

This raises questions such as: Do water managers realise that climate is changing? Do they recognise the implications for their tasks and objectives? If so, are they able to react timely and adequately? What constitute institutional barriers to implement certain proposed flood risk mitigation schemes? And what, given current societal trends, are the

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50 Institute for Environmental Studies, Vrije Universiteit, Amsterdam.

51 Adaptation is the knowing and unknowing response of actors and systems to climate change – either in anticipation of or in reaction to – so as to mitigate the negative impacts of climate change and maximise its positive impacts, whether successful or not.

prospects for adapting institutions to find better and feasible responses to climate change?

In this paper, we focus on water management in the Netherlands, in particular management of flood risks posed by the large rivers (Meuse and Rhine). In this context, the questions of awareness of climate change and its implications are not particularly interesting, as nearly everyone who has something to do with Dutch water management knows about climate change. We therefore largely restrict ourselves to the conflict between what should be done about increasing flood risks and what can be done in the current institutional context. This automatically leads us to propose institutional reform.

The paper follows this route. We sketch the current developments in water management against the background of societal trends, and extrapolate these to the future (Section 8.2). Section 8.3 lays out solutions to current (*Maaswerken*) and anticipated (*Rijn op Termijn*) flood risks. Both sections are based on the earlier chapters of the present monograph. The institutional responses to these initiatives are discussed in Section 8.4. Section 8.5 concludes.

8.2 Flood risk management and trends in water management

The Netherlands is densely populated with prosperous and well-educated people. Decisions are typically made through consensus. The country is formed by the deltas of the rivers Scheldt, Meuse and Rhine. The country is flat. Centuries of subsidence have left most of the country below mean sea and river level. Dikes and dunes are supposed to protect the country from floods. Centuries of floods have left the people rather nervous and inventive about flood risk management. Water flows are regulated through an elaborate system of canals, sluices and pumps. Dutch civil engineers are amongst the best in the world if it comes to water works.

Flood risk management is only one part of water management, although it has top priority in the country. Under current national law, it is required that flood risk, inland navigation, fisheries, leisure, rivers as fresh water resource, nature conservation be managed in an integrated way. Recently, under the expectation of increased flood risks, the water management community advocates a more important position of water management in national spatial planning. More precisely, the possibilities to deal with very high river discharges should become one of the guiding principles for national spatial planning.

Reflecting the multiple interests of rivers, water management is carried out by a complex array of authorities. An overview of the main players in Dutch water management and their main responsibilities can be found in Van den Berg and van Hall (1997), Van der Grijp and Olsthoorn (2000), Van Hall (1997a), Mostert (1997) and Perdok (1995). Van der Grijp and Olsthoorn (2000) identify four major trends in water management over the last 50 years. These trends may well continue to change institutions in the same direction for the coming 50 years.

The first trend is *internationalisation*, or the geographical extension of policy from the local scale to the watershed. Water management policy, traditionally a matter of local and regional authorities, was first nationalised by Louis Napoleon, viceroy for this brother Boneparte (cf. Langen and Tol, 1998, and Tol and Langen, 2000, for a more extensive review of the history of flood management in The Netherlands). The responsibility of the central government for water issues was reconfirmed in the Constitution of 1848, and strengthened in the Constitution of 1983. Operational responsibility for flood safety rests with the water boards. The flood of 1953 led to a reorganisation of the water boards. There were over 2500 semi-professional water boards in 1950. There are less than 50 now, fully professional (Van den Berg and Van Hall, 1997). Geographical up-scaling of institutions continues at an international level. The 1986 Sandoz incident[52] gave teeth to the International Rhine Committee, though initially only to chew on water quality and pollution issues. Since the floods of 1995, mostly in Germany, its mandate has included flood control (van der Grijp and Olsthoorn, 2000). The Helsinki Convention provided a framework for treaties on the Meuse (De Villeneuve, 1996). The new EU Water Directive is likely to reinforce the trend of internationalisation of river water management.

The second trend is *integration*. Water has many roles, and water management serves many purposes. These include drinking water, irrigation water, navigation, recreation, nature preservation, fisheries, and cooling water. Problems may arise because of floods, droughts, and contamination. All these roles and the associated management goals come together in one system, and pretending that interactions do not exist may be seriously misleading or counterproductive. Yet, different aspects of water are often still managed by different entities with different, occasionally conflicting interests. Over the years, and particularly in the last decade, integration of water issues is pushed by the central government (Mostert, 1998). The operational reality lags behind, though (Gilhuis and Menninga, 1996). It should be noted that, currently, integration more or less stops where the water ends. Land use planning and water management remain largely separated, although there is considerable mutual consultation (Van Hall, 1997b).

The third trend is *democratisation*. Engineers, bureaucrats and politicians have less to say about water management than they used to. More stakeholders get increasingly involved. This is marked by the gradual extension of voting rights in water boards from large landowners to all inhabitants (completed in 1994) (Gilhuis and Menninga, 1996; Katsburg, 1996). More importantly, elaborate impact assessments of proposed projects are now required by law, media attention to planned infrastructure can be enormous, and public hearings are extensive (van der Grijp and Olsthoorn, 2000). Although this increases the democratic nature of decision making and thereby the quality of planning and implementation, it may also increase its costs and considerably slows down the process.

Note that, in reaction to the (near) floods of 1995, the *Deltaplan Grote Rivieren* (delta plan large rivers) was introduced. The accompanying law accelerates and streamlines decision making procedures, partially reversing the democratisation trend (Kroon, 1997). This law has only a limited scope. However, there is a tendency to move public participation in decision making to a more strategic level, leaving less room for ‘not in my backyard’ sentiments.

The fourth trend is *naturisation*. Water management used to be decided on a narrow economic and engineering calculus, and used to be biased by typical civil engineering thinking. The upsurge of the environmental movement in the 1970s, reinforcing the older

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[52] A factory spilled large quantities of poisonous chemicals during a fire.

movement for protecting landscape and cultural heritage, changed this. Notably, during that time, plans to impolder the IJssel Lake and the Waddensea were ditched, and plans to close the Eastern Scheldt Estuary were changed, all in favour of nature preservation (Hisschemoller, 1985). The thoughts behind these isolated decisions are now pervasive. Civil engineering has given way to ecological engineering. Rivers are no longer just transport channels and a resource of fresh water, but important recreation areas and parts of the Ecological Main Structure. The current round of dike reinforcements is supposed to be the last one. After 2000, flood risk management should make use of natural dynamics, rather than concrete and steel (Van Hall, 1997a).

These trends both constrain and enable future management options. Together, they determine what options are feasible, and which one is likely to be adopted. Reactions to climate change should be placed against this background.

8.3 A radical plan to cope with climate change

The implications of climate change may be quite severe for river deltas such as the Netherlands. The majority of general circulation models (GCMs) project winter precipitation to increase in the Rhine river basin.[53] This would increase the risk of river floods (Kwadijk and Middelkoop, 1994; Parmet and Raak, 1995).[54] Earlier snowmelt in the Alps could further enhance river floods. Sea level rise would slow the outflow of water. In the Netherlands, the impact of climate change on water resources and flood risks is clearly recognised. The works of the Committee Boertien is one example, but there are more (cf. van der Grijp and Olsthoorn, 2000).

This committee studied flood risk management along the river Meuse. The Meuse is a medium-sized rain-fed river originating in the north of France, traversing Belgium and the Netherlands to mouth in the North Sea. The Limburg Meuse Valley is unique for the Netherlands[55] because it is hilly and the soil is such that water would seep underneath the dike if there were one. Severe floods in 1993 led the government to install Committee Boertien (officially: *Commissie Watersnood Maas*) with the assignment to assess what could be done to avoid flood damages in the future (cf. CWM, 1994). The findings of this committee with respect to the benefits of possible options to reduce flood risks with and without climate change (Table 8.1) are interesting.

Table 8.1 shows the estimated annual average flood damage for various management scenarios. The Committee Boertien included robustness to climate change in their study, using a temperature and precipitation scenario for the year 2050. A relatively modest change in climate (a 2ºC temperature increase and a 10% precipitation increase in win-

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[53] That is, GCMs that look at the effect of greenhouse gas emissions generally project the northern half of Europe to get wetter. GCMs that also include sulphate aerosols occasionally project a drying of northern Europe (Brignall *et al.*, 1998). However, acidification policies in Europe rapidly decrease sulphur emissions (Gruebler, 1998).

[54] Note that sizeable rivers such as the Rhine react to above-average rainfall for an extended period (at least a month) over the whole watershed (Penning-Rowsell and Fordham, 1994). GCMs are more reliable for this type of floods than for flash floods and floods of small rivers.

[55] although common in the rest of the world …

ter) would more than double the average annual damage. Medium-sized European rivers typically respond in this way (Handmer *et al.*, 1998; Riebsame *et al.*, 1995). But under the studied management interventions average damage would be kept below the 1995 damage. However, the studied management interventions would reduce average damage by a factor 3 to 15. Thus, in the Limburg Meuse Valley, the effect of management dominates the effect of climate. That is, the impact of climate change is ‘noise’ compared to the ‘signal’ that management effectuates. This is true for many impacts of climate change (Tol *et al.*, 1998).

Table 8.1 Annual average damage (in million guilder per year) due to river floods in the Limburg Meuse Valley[a]

Policy intervention	1995	2050[b]
Do nothing	9.9	21.8
Embankments	0.7	1.5
Nature development	0.6-3.3	1.4-7.3
Deepen summer bed	3.5	7.4

[a] Average damage is estimated using a hydrological model of the Meuse, coupled to a GIS database of the stock at risk from flooding. Modelled flood damage is calibrated to the actual flood damage of 1995 (without policy intervention). Input comes from a stochastic weather generator, calibrated to current climate and a scenario of future climate.

[b] Winter temperatures 2°C higher than today, winter precipitation 10% up.

Source: Schuurman 1995.

The situation is completely different, however, for flood risks along the river Rhine. The flood risks posed by the Rhine and its branches are much larger than the flood risks of the Scheldt and the Meuse. This has to do with the large discharge of the Rhine, and the fact that the areas adjacent to the river are polders. Most polders are below mean river level, so if water gets in, it needs to be pumped out, which takes a long time. If a dike breaks, fast flowing water would do a lot of damage. The traditional first response to expectations of increased risk would be to raise dikes. However, this approach is widely rejected as not sustainable.

Unfortunately, no one has found a neat solution so far. A default solution would be to continue current and past practice of solving problems as they emerge (that is, after some harm is done), and picking a solution that does not upset too much of the delicate balance of interests. This has proven to be sort of successful, at least, in the short run. Frequently, problems not solved but were rather shifted from one place to the next, or re-emerged in a different form some time later (cf. Langen and Tol, 1998, Tol and Langen, 2000). It is doubtful whether this strategy will be of great help in dealing with climate change, because of the scale of the problem and the state of the current water management system. Works to improve the weakest dikes were accelerated in 1995. No definite plans are decided upon for after 2000. Proposals, focusing on increasing the retention and recreational value of the flood plains, tweak the water discharge system, but do not substantially alter it.

The alternative would be a radical re-design of the delta of the water management system. The research institute Delft Hydraulics (1998) produced a blueprint *Rijn op Termijn*. This plan is not painless, but it could take away a number of current problems and prevent a number of future ones. The core element of the blueprint is to redistribute the water flow over the three branches of the Rhine, viz. the Waal, the Lek and the IJssel; see Figure 8.1. The Waal discharges most of the water. It is the major shipping route from Rotterdam to Germany and back. The Lek and the IJssel are less important.

Climate change is likely to increase the peak flow. In the study of Delft Hydraulics, the design peak discharge is assumed to increase from 15,000 m^3/s to 20,000 m^3/s.

The design peak discharge is the maximum river flow – as measured at Lobith where the Rhine enters the Netherlands – that occurs without causing severe floods downstream. The design peak discharge constitutes the first element of the guidelines for flood protection. The second element of flood protection is the acceptable risk of dike overtopping. This risk is set by Parliament, upon advice of a committee of wise men (see Olsthoorn, 2000). The current risk is 1/1250 year, that is, river dikes and other water works should be built such that they fail less than once every 1250 years. The tolerated risk is so low because the would-be damage is so high. Should a dike break or be overtopped, a large polder would fill with fast streaming water. It would take months to get the water out. The acceptable risk does not comprise a valuation of personal risks.

Confronted with a higher peak flow, one could do several things. Firstly, water management authorities could hope that the Germans would solve the problem, and store excess water somewhere in a reservoir. The current discussion in Germany suggests that this is an unlikely scenario. Firstly, water management is the terrain of the *Bundeslaender* rather than the federal government, which hampers any structural solution to the flood problems along the Rhine (Kraemer, personal communication, 1999). Secondly, building (temporary) reservoirs is not the preferred option from a German perspective (Delft Hydraulics, 1998).

Secondly, one could accept more frequent floods. This is not an issue in the Netherlands. The 1995 evacuation of 1 in 60 of the population is still fresh in people's minds, and not to be repeated. Recent attempts to introduce flood risk insurance failed for lack of interest by insurers and reinsurers (Tol, 1998a,b; Van Schoubroeck, 1997, 1999). The Netherlands is becoming a 'zero-risk' society, that is, the tolerance of involuntary risks is low and decreasing.

Thirdly, one could build higher dikes. This runs against the trend of naturisation, and is counter to the recently adopted government policy. Dikes are considered ugly and spoil the landscape. Dikes are also expensive, particularly if done properly. A lot of river dikes were built and rebuilt over the centuries. It is seldom known what they were made of, and thus hard to re-engineer (Delft Hydraulics, 1998). Furthermore, there is always a residual risk of dike failure, particularly in the light of the uncertainty about climate change projections. Floods in the densely populated areas of Noord-Brabant and Zuid-Holland or the petrochemical industry near Rotterdam would be extremely expensive.

Fourthly, one could increase the discharge capacity of all three branches, by deepening and widening the river bed. However, getting the water as quickly as possible to the North Sea would cause other problems. Increasing discharge capacity would reduce water flows in summer, which, particularly if combined with higher temperatures, would enhance the probability of droughts, hurting nature, recreation, agriculture, drinking water and navigation. The current, already elaborate system of sluices would need to be substantially and expensively extended to prevent this. Reliable and speedy navigation is important for Rotterdam Harbour, competing with Antwerp and Hamburg. Standards for navigability of the Rhine are laid down in a treaty between the Netherlands and Germany (van der Grijp and Olsthoorn, 2000).

Fifthly, one could dig a fourth branch, which would inevitably flow through the hilly and prosporous region of *'t Gooi*. A fourth branch would be expensive – as it would require land already used for other purposes – prone of failure – since it would run against natural geography – and invoke fierce opposition – as it would require digging up the gardens of well-to-do and well-connected people (Delft Hydraulics, 1998).

Sixthly, one could construct a bypass. A bypass is a river branch that only occasionally discharges water. Delft Hydraulics (1998) opts for this idea. Figure 8.1 shows the consequences. If the discharge of the Rhine at Lobith is less than 15,000 m^3/s, everything remains as it is now. All water in excess of 15,000 m^3/s is discharged northwards, through the countryside, and later joined with the river IJssel to mouth in the IJssel Lake. From there, the water would flood parts of the provinces Gelderland and Overijssel, eventually discharging in the IJssel Lake. It then needs to be pumped into the Waddensea.

The plan contains two more features. The Waal (a second branch of the Rhine) is turned into a canal, so that navigation is improved. The Lek (a third Rhine branch) is turned into a nature reserve.

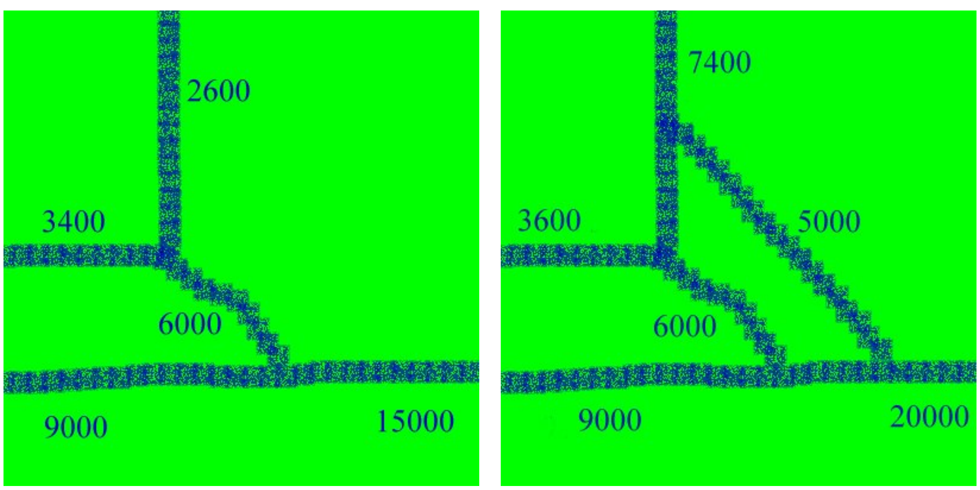

Figure 8.1 Current (left panel) and proposed future (right panel) distribution of the Rhine's peak flow over its branches. The 5,000 m^3/s branch is additional and only used in times of high water. It involves digging a new canal but largely relies on an earlier branch of the river. Source: Delft Hydraulics, 1998.

The bypass as advocated by Delft Hydraulics (1998) is obviously not the only option, and perhaps not the best one. However, it is the most detailed proposal and clearly demonstrates the scale of intervention that is required to durably manage river flood risks in the Netherlands. In the next section, we review the institutional implications of intervention at this scale.

8.4 Institutional response

The implications for the provinces of Gelderland and Overijssel are quite drastic. Figure 8.2 compares the current and the proposed situation. Large stretches of land would need to be set aside for the newly created bypass. Isolated houses and hamlets would need to go, some villages and towns would need to be protected by circular dikes. The occasional flooding would be detrimental for agriculture, so that nature development would be the alternative. The bypass is designed so as to minimise such impacts, but they are still large.

Figure 8.2 The proposed bypass and restructured IJssel river. The light grey areas are currently flood-safe, but will occasionally flood in the proposed situation. Source: Delft Hydraulics, 1998. See also Figure 6.2.

Placed in the context of *democratisation*, it is unclear whether this or a similar plan will ever make it. Locals would be asked to leave house and hearth for a questionable cause. In the series of interviews we conducted in the area (see Van der Werff, 2000), one of interviewees remarked “Climate change? Ha! One professor says it gets wetter, the other says it gets drier”. Fact is, the current decision making process lends substantial ear to “not in my polder” feelings. The results of the series of interviews suggest that farmers may be willing to move, provided that financial compensation is adequate. However, they would regret the break up of social life. Recent migrants to the region particularly appreciate the current, open landscape, and thus oppose new dikes and other infrastructure. Both groups, however, would be willing to accept individual losses for the greater good, provided that social benefits are clear to them. On the other hand, both original and new residents could and would resist government plans if the necessity is unclear, compensation inadequate, or if something goes wrong in the communication process. New residents, in particular, are well-organised, and effectively influenced the planning of the *Betuwelijn* (a major new railroad and part of the Trans European Network (TEN)) and dike reinforcements in the same area (van der Grijp and Olsthoorn, 2000).

Another issue is that the people of Gelderland and Overijssel would be asked to bear most of the costs (that is, increased flood risks), whereas the benefits (reduced floods risks) would largely befall the people of Noord-Brabant and Holland. Similar regional sentiments, particularly tensions between centre (*i.e.* Holland and Utrecht) and periphery (the rest of the country), have played a role in the management of the Limburg Meuse. People in Limburg subsidise flood management in the west of The Netherlands, while flood risks are substantially higher in Limburg. This is one of the reasons why the central government seeks to reduce flood risks in Limburg (anonymous government consultant, personal communication, 1993).

The Delft Hydraulics plan is not inconsistent with the trend of *naturisation*, particularly because the Waal does not need higher dikes and the Lek is turned into a nature reserve. The actual bypass requires hard engineering, though, and new dikes are needed to protect the towns and villages of Gelderland and Overijssel. As mentioned above, the plan disregards upstream solutions in Germany, ignoring the trend of *internationalisation*.

The plan requires *integration* to be taken two steps further. Most importantly, water management and land use planning need to be interwoven. At the moment, the relevant authorities merely talk to one another, and only occasionally listen. A recent example of deficient coordination is the *Betuwelijn*[56], the planned location of which gets in the way of flood safety reinforcements.

The difficulties in getting different authorities and other stakeholders to agree on policies and actions that address problems overarching specific interests are recognised. New ideas for water management (*e.g.* van Rooy and de Jong, 1995) focus on the process of finding feasible approaches to deal with an uncertain future rather than on attempting to find support for a pre-engineered solution to a pre-defined problem. The initiative of Delft Hydraulics may be seen as an attempt to start such a process.

Just how hard this is, is shown by the *Maaswerken* project (van der Grijp and Warner, 2000). This project aims to improve flood safety along the Meuse. At the same time, it seeks to further commercial mining of sand and gravel and to develop nature. Project planning and execution will cover a period of at least 25 years, with the planning process for the constituent projects already starting in the early 1990s and the actual realisation of the full project foreseen for the period from 2000 up to 2015. However, the project appears to be the source of a broad range of conflicts and is therefore proceeding less successfully than expected. As a consequence, the public support base for the *Maaswerken* project has started to crumble off. Time and again, it is stated that there must be a project approach that is simpler, cheaper and more effective.

The trends of integration of policy objectives and of naturisation are clearly at work in the *Maaswerken* project, and so is internationalisation (van der Grijp and Warner, 2000). In the early 1990s, the Belgian authorities have expressed a positive attitude towards the *Maaswerken* project and have made their own version based on a similar philosophy. Co-operation with Belgium is important because it will lead to a more cost-effective execution of the Dutch project. Regarding democratisation, the *Maaswerken* project

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[56] A rail track designated for goods transport only from Rotterdam harbour to the German hinterland. Part of the Trans-European Network (TEN).

counts as an extensive exercise in formal and informal participation. However, the project group adopted a 'top-down selling' approach rather than a 'horizontal co-production' approach. Recently, though, a remarkable initiative was taken by a group of seven municipalities. They developed their own alternative plan (*Plan Maascorridor*) as a protest against the earlier, official plans for the heightening of embankments. This plan is now under serious consideration of the project group *Maaswerken*, sponsored by the national government.

The actual *Maaswerken* project thus combines all elements of possible Rhine projects, although the *Maaswerken* project is smaller and less complex than a restructuring of the Rhine would be. Nonetheless, the *Maaswerken* project is plagued by troubles. Important lessons can be learned from this experience. Ever since its inception in 1990, the project has been overtaken by events, including floods along the Meuse and the Rhine, new regulations from The Hague, and new initiatives from Brussels. Initially envisaged as three separate projects, the *Maaswerken* project grew more complex over time. Priorities were revisited time and again. The budget was often revised too, and funding continues to be uncertain. In addition, the regulatory framework to enable a project of this size is not well-developed. In this context, it has been argued that infrastructural projects such as the *Maaswerken* need new legal instruments, because unprecedented situations are met, or situations where the present legislation is an obstacle to achieve real solutions (Van Leussen *et al*., 2000).

The present situation with regard to the *Maaswerken* project is that the planning process is still underway, and that the execution of the actual works has not been started, except for some pilot projects. At the moment, the major issues at stake are the conclusion of an agreement with the consortium of gravel extraction companies, the technical feasibility of the envisaged measures, the inclusion of climate change in the calculations about protection levels and the time schedule for the realisation of the measures. The time schedule determines who is protected first.

8.5 Conclusion

Climate change could seriously increase flood risks in the Netherlands. This is recognised by the water management authorities. Structural solutions, an example of which for the Rhine is sketched above, would require strategic thinking, political courage, individual sacrifice for the greater good, careful communication and integration of land use planning and water management. The current institutional setting is such that a structural solution is likely to give way to incidental solutions.

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9. Conclusions

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9.1 What happened?

The history of floods explains much of contemporary thinking about flood safety in the Netherlands. The 1953 coastal flood catastrophe is still a vivid reference for flood risk management. During most of the post-war period, high river discharges failed to occur. However, in the nineties, riverine floods (river Meuse) and near-flood disasters (river Rhine) confirmed the reality of flood risk.

Both events have prompted institutional change. The 1953 catastrophe resulted in the national government taking formal responsibility for flood risks and establishing guidelines for flood risk management. A principal guideline refers to required heights of dikes along the rivers. This guideline reflected fixed expectations of the expected frequencies of very high water discharges.

Implementation of the guideline failed initially. One reason is that traditional engineering approaches manage flood risks at the expense of nature, landscape and cultural heritage, items the values of which are on the rise (naturisation). In riverine flood risk management, the resulting conflicts proved very hard to resolve and concrete risk management to implement the safety standards was very limited.

A new spur occurred after the 1993 and 1995 (near) flood events. Its direct effects were mending weak spots in dikes (*i.e.* dike reinforcement), improvements of flood warning systems and more municipalities having (improved) contingency plans in place. It also helped conclude a discussion on new legislation (Water Embankment Act).

In the Netherlands, flood risk management is part of large water policy domain. Since the sixties, policy makers put forward integrated water management as a principal element of policy. Strategic planning that considers all interests related to water, is an important element of this approach.

In a debate on long-term strategies climate change comes in view naturally. Current thinking about climate change means: (*i*) the probability of very high river discharge is on the rise in the Netherlands and (*ii*) the rate of change is not well known.

This analysis (and a second geophysical process in the Netherlands that enhances flood risk: subsidence) asks for approaches to flood risk management that are more robust with respect to assumptions then the traditional dike-heightening approach. These approaches will extend beyond the current water policy domain. For instance, Dutch policy makers

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turn to their upstream colleagues and influence policies beyond Dutch borders, initiatives have been taken. However, a more profound approach is probably needed. The key is to find and reserve land for temporary storage or for discharge capacity of occasional excess water.

Rather concrete proposals for designating areas to process excess water have already been put forward. For such areas, it would mean that the possibilities for development would be constrained and that occasionally people living in those areas will be confronted with inundations. This is head on with the notion of the zero-risk society, as is shown by the emotions in some reactions of locals to concrete ideas put forward by the minister of Transport and Water Management.

9.2 Adaptive capacity

The focus of this study is on the ability of institutions to adapt to climate change. In Chapter 1, we argued that institutions may be the crucial element of adaptive capacity in The Netherlands. We also argued that adaptation to changes in flood risks in The Netherlands would take the shape of major interventions in river bed and catchments. Further, we questioned whether current flood management institutions would be capable of successfully planning and implementing large projects. From the previous section, one may conclude that 'strategic level institutions' adapted (if climate change is revealed by events). However, adaptation should occur at other levels too.

Two questions emerge:

- How do people feel when confronted with such plans that regard their village? (public acceptability of adaptation)
- Is the current institutional structure – the intricate system of laws, procedures and customs – fit to timely accommodate changes? (administrative feasibility of adaptation)

People of *Helhoek*, a village in the middle of such foreseen overflow area, gave answers to the first question. These answers reveal *post-modern*, *modern* and *pre-modern* social dynamics. Acceptation stems from a *post-modern* appreciation of a necessity to address increasing flood risk and a democratic attitude to policy making. A third reason relates to the way these new approaches are framed. Reserving land for water discharge implies the creation of natural areas. So, bypasses are framed as 'green rivers'. Under a naturisation trend people are sensitive to these arguments (or *vice versa*). Rejection results from a defence of *pre-modern* societal attributes of close communities, which would be torn apart by forced, permanent evacuation. From a *modern* stance, people will negotiate on financial compensation from the state. We note that Helhoek may not be an exemplary village because, for instance, an important contextual factor is the existence of other plans for infrastructure works (railway, motorways). Nevertheless, the indications are that, in the Netherlands, people are potentially ready to accept adaptation projects, provided that they see the need and that project planning and implementation follows acceptable procedures and delivers acceptable outcomes.

People may be ready under certain conditions, but how about institutions that govern the required negotiations? The area in which changes are likely to be necessary is the shared domain of flood risk policy and land use planning. In other words, flood risk management should become a major topic in spatial planning. Our analysis of the planning and execution of a river basin project in the valley of the river Meuse (the *Maaswerken*) provides examples of the various conflicts that should be dealt with. In the case of the *Maaswerken*, these include the distribution of costs between (governmental) stakeholders, the handling and storage of heavily contaminated dredging material, the accuracy of technical calculations, the restriction in land-use options, and frustrations of the local population about their peripheral position in decision-making. One of the options for breaking deadlocks is to declare the future State Government Project Procedure (*Rijksprojectenprocedure*) applicable. In the meantime, the responsible authorities have to work with the large amount of procedures that are prescribed in the various laws that the many issues touch upon.

So the legal and administrative instruments to facilitate planning, negotiations, decision-making and execution of major infrastructure works in the catchment area of the Rhine/Meuse seem not adequate. This has to do with the complexity of the problems and the range of interests and stakeholders that are involved. Under such conditions, interactive policy making, learning processes and open planning are likely the ways to identify and decide on operational level policies that have public support.

In sum, decision-makers in the Netherlands are well aware of the risks of increased flooding due to climate change. The technologies and economic means to cope with potentially increased risks are available. Current planning and implementation procedures, however, are not adequate. This is acknowledged, and there are plans to overcome these shortcomings. Since unpredictable contextual factors (*e.g.* the occurrence of floods) may eventually be decisive, time will tell whether this is sufficient.